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New Advances in Central
European Neolithic Research



Edited by

Daniela Hofmann
and Penny Bickle

Oxbow Books

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Oxbow Books
Oxford and Oakville

Published by
Oxbow Books, Oxford

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ISBN 978-1-84217-353-4
EPUB ISBN: 978-1-78297-328-7
PRC ISBN: 978-1-78297-329-4

This book is available direct from

Oxbow Books
Phone: 01865-241249 Fax: 794449

and

The David Brown Book Company
PO Box 511, Oakville, CT 06779, USA
Phone: 860-945-9329; Fax: 860-945-9468

or from our website

www.oxbowbooks.com

Library of Congress Cataloging-in-Publication Data

Creating communities : new advances in Central European neolithic research / edited by Daniela Hofmann and Penny Bickle.

p. cm.

ISBN 978-1-84217-353-4

1. Bandkeramik culture. 2. Neolithic period--Europe, Central. 3. Neolithic peoples--Europe, Central. 4. Europe, Central--Antiquities. 5. Excavations (Archaeology)--Europe, Central. I. Hofmann, Daniela. II. Bickle, Penny.

GN776.2.B3C74 2009
943--dc22

2009018086

Cover image: an LBK longhouse at Wang, southern Bavaria, during excavation in September 2008.

Photo: Alasdair Whittle

Printed in Great Britain by
Hobbs the Printers Ltd, Totton, Hampshire.

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Introduction: researching across borders

Penny Bickle and Daniela Hofmann

Introduction

Unquestionably, the LBK is one of the best researched Neolithic cultures in Europe. Substantial information on architecture, settlement patterns, economic behaviour, exchange and mortuary rites is available, and the quantity of excavation and specialist reports, theses and micro-regional studies in various European countries now escapes easy overview. Why, then, this book?

This volume originated at a 2006 EAA session at Krakow entitled 'Advances in Central European Neolithic research' which aimed to provide a forum for PhD students and newly established researchers to present their ideas to a wider audience, sharing approaches across traditional research boundaries. As the field becomes much more specialised, it is often hard to keep track of where research concerns converge. In the course of the session, it became clear that presentations consistently raised certain key themes which cross-cut, but also reinforced some of the established research foci. These can best be characterised as the nature and interplay of various scales of social interaction and the linked concern with identities, be they individual, local, regional, or ethnic and culture-wide.

The aims of this book are hence not only to make a wealth of scattered material in various European languages available to an English-speaking audience, but also to raise more fundamental questions about the investigation of identity, community and change in prehistory. The nature and quality of the LBK material invites reflection on how different scales of social life can best be interconnected. Modderman's (1988) dictum of 'diversity in uniformity' for the LBK is frequently quoted, but we are still grappling to explain the social mechanisms behind these patterns. How can LBK material culture be so instantly recognisable and comparable over vast geographical areas and over half a millennium, while at the same time showing regional variations in almost every respect? How are these similarities and differences negotiated at various social levels?

One reason for archaeology's persistent problems in explaining this point is the dominant and pervasive tendency to think in neatly packaged, bounded building blocks of social interaction: beginning with the individual and working our way up via the household, settlement, settlement cell and micro-region to larger regions and eventually the culture. All these elements function a bit like Lego bricks,

where several small ones can be connected together to form the next largest entity, but without their own boundaries being questioned in the process. Traditionally there has been a tendency to aim modelling at the top tiers of this hierarchy of bricks: at social structure and even culture-wide norms. It is here that we saw the need to depart from the established canon to open up new trajectories of investigation, but without creating an artificial focus on just the small scale. To be successful, LBK archaeology needs to embrace a variety of approaches and voices, and this is what the volume represents.

Breaking boundaries

Traditionally, in LBK studies some entities and scales of interaction have monopolized attention, while others have remained neglected. Personhood and the boundaries of the self are not often discussed (but see Jones 2005; Hofmann 2007; Hofmann and Whittle 2008). Where individual identity is problematised, this generally takes the form of assigning people to groups or categories, such as farmer: hunter, local: incomer, rich: poor or male: female. These identities are treated as unambiguous and monolithic (e.g. Lüning 1988; Jeunesse 1997; Price and Bentley 2005; Tillmann 1993). Yet a different picture could emerge if the interplay of various possible affiliations took centre stage. How do people negotiate their own position with regards to multiple, overlapping and cross-cutting groupings? Recently, Gronenborn (2007, 84; see also Zvelebil 2004) has envisaged LBK groups as ‘multi-tradition communities’ and Robb and Miracle (2007) have highlighted the possible heterogeneity of responses to farmer/forager interaction in the LBK area. The challenge now is how to write detailed narratives of specific sites or regions that deal with the different scales of community present in the LBK.

Households, in contrast, hold a particularly strong position in models of LBK social structure (e.g. Bogucki 1988; Claßen 2005; Lüning 2005; Strien 2005; van de Velde 1990). Based on long-term intensive research mostly in the Rhineland, the individual house has come to be regarded as the material manifestation of a largely independent household, the ‘fundamental unit of LBK settlement and social structure’ (Lüning 1997, 38; authors’ translation). This unit is perpetuated through time as the structure is renewed roughly every generation, but in a circumscribed area of the settlement. Clusters of houses on site plans are hence the congealed history of a remarkably stable social unit, a ‘ward’. The large distances observable between contemporary houses emphasise their independence (Lüning 1982; Stehli 1994). However, in spite of the growing recognition of difference between individuals, for instance in their possible provenance or the economic activities they carried out (Bentley 2007; Price *et al.* 2001), ties cross-cutting households remain very much understated as an important part of social relationships. Could such multiple allegiances not have served as a counterpoint or even challenge to the primacy of the ‘household’ as a social unit?

The settlement as a unit has received far less attention. Houses of different sizes or with different artefact assemblages are occasionally directly compared to elucidate status differences (e.g. Pavlí 2000; van de Velde 1990), but the resulting models of big men or chiefdom societies remain quite generalized. There are many possible connections and relationships between households in the course of daily

interaction, but they and their influence on the creation of a wider community of co-residents are not part of the discussion. Occasionally, settlements are seen to act in unison, for instance in discussions of flint trading. Here, sites are classed as either producer or consumer settlements, with a concomitant difference in status (e.g. Zimmermann 1995). It is not often explored whether this reflects on all possible relations between the sites, nor whether it is relevant to all their inhabitants to the same degree.

Yet, as co-operation and complementarity between households are increasingly recognised (e.g. Hachem 1997; 2000), we can begin to treat settlements as more than collections of individual houses. Routine activities in shared spaces between structures, or ad-hoc work groups, cross-cut households and can create a wider sense of community at the settlement level. Again, however, it is important to stress that sharing routine tasks does not result in an automatic affinity, a 'natural community' (for discussion, see Isbell 2000). Much like individuals or households, the boundaries of settlement communities are open, cross-cut by multiple affiliations and at least partly 'invented' and in need of reiteration through daily performance. In spite of this openness and fluidity, communities have real emotional salience for the individuals involved and are hence central for a person's sense of belonging (Amit 2002).

Regions have mostly been defined on the basis of ceramic styles, which diversify over the course of the LBK. It is also possible to identify regional trends in house architecture (Coudart 1998) or burial (Jeunesse 1995; 1997), or indeed with regards to preferred animal and plant species exploited (Lüning 2000; Bogaard 2004). It is not always clear whether these differently defined regions overlap to a significant degree. Efforts have been made to elucidate the kinds of networks that may have resulted in regional patterns of material culture, for instance the transmission of pottery design through marriage patterns (Friedrich 1994; Krahn 2003; Krahn-Schigliol 2005; Sommer 2001; Strien 2000). In other cases, the distribution of flint trading networks seems to suggest abrupt boundaries within micro-regions (Zimmermann 1995) and this is now being recognised for other items of material culture (see e.g. Pechtl this volume; Kneipp 1995). Only sustained further studies which combine several categories of evidence will be able to elucidate the nature and intensity of these different possible connections. It is likely that instead of simple networks of clearly defined dots connected by straight lines, the result will be more fluid and multi-scalar (Whittle 2003).

At the culture level, relations between the LBK and other groups are mostly problematised at times of transition. This is clearest in the enduring debate about the relative role of incomers and native populations in the adoption of agriculture in central Europe. Although in recent years prevailing models have been revised to accord a greater place to hunter-gatherer involvement (e.g. Gronenborn 1999; Whittle 1996; for an overview, see Scharl 2004), especially in western areas of the LBK where these groups are archaeologically more visible, there is still a tendency to cast the transition in terms of two mutually exclusive, closed ethnic groups (for a recent criticism, see Robb and Miracle 2007).

In part, this is also suggested for the end of the LBK and its dissolution into various regional middle Neolithic culture groups. Here, however, there is a greater willingness to identify prime movers other than population displacement. Climatic instabilities and religious upheaval (Strien and Gronenborn 2005; Spatz 2003) are

suggested as factors leading to a violent breakdown in social relations (Golitzko and Keeley 2007) and massacres such as that observed at Talheim, southwest Germany (Wahl and König 1987) and Asparn, Lower Austria (Teschler-Nicola 1996), or the indirect evidence for hostilities at Kückhöven in the Rhineland (Weiner 1998). These developments are seen to reinforce a long-lasting trend towards regionalisation. In some areas, models of population displacement are favoured for the onset of the middle Neolithic (e.g. Riedhammer 2006).

Instead of stressing such either-or concepts of identity, it may be more useful to investigate how the material culture of the LBK could be used to integrate populations of varied backgrounds at a local level. Identities are rarely clear-cut and exclusive in this way, but stressed, de-emphasised and formed locally in response to specific conditions. Whilst we have been moving towards multiple narratives of the transition to agriculture, we must also now realize the possibility of continuous variations in the trajectory of LBK development in different areas and hence of different possible endings. Whether these involved all aspects of life equally, and where the boundaries between sameness and difference were drawn, has to be established for each case.

To varying degrees, the papers in this volume grapple with the inadequacies of received categories and work towards more nuanced models of scales of social action. The challenge is to re-think the LBK as a fusion of intersecting networks, each open-ended and allowing for a degree of flexibility, but also integrating diverse actors into a shared frame of reference. Contacts, the nature and extent of communities, the place of routine activities in establishing and maintaining identities, the multifaceted nature of the latter and issues of change are some of the uniting themes. Although using different kinds of evidence and concentrating on different spatial, chronological or social scales, the papers collectively mark a move towards problematising, dissolving and recasting our traditional Lego blocks – not to abandon the results of previous research wholesale or uncritically, but to expand it into new and fruitful avenues.

Thus, the quality and quantity of data available on the LBK do not mean we are any closer to unravelling its secrets. This area provides a tantalizing challenge to investigate how past societies created and coped with difference, similarity and integration, established and maintained identities, communities and networks, and how this variously connected and cross-cut social worlds transformed over time. In this volume, there are many possible convergences between papers, although each author approaches their material from a distinct starting point. Here, we briefly present the papers according to their prevailing theme, but there are numerous overlaps in approach and subject matter throughout the volume, which works against a rigid division into sections. We thus leave it up to the readers to forge further connections of their own.

Beginnings

The LBK retains a crucial role in discussions of the Mesolithic-Neolithic transition on a Europe-wide basis. In contrast to the perhaps more indigenous adoptions of farming practices that occurred along the Atlantic façade (Whittle 2003), the rapid and apparently wholesale transformations which the LBK caused in central Europe are often seen as a strong argument in support of colonisation, with very limited

input from native foragers (e.g. Bogucki 2000). However, there is now increasing recognition within LBK studies that the spread of this phenomenon was by no means a simple expansion of colonising farmers but varied in the course of its movements west and, much less intensively discussed by western European scholars, east (e.g. Gronenborn 1999; 2007; Robb and Miracle 2007; Whittle 1996; 2003; Whittle and Cummings 2007).

While the turn towards more regional considerations allows for more detailed and subtle understandings of the social worlds late Mesolithic and early Neolithic communities lived in, it also creates new sets of questions that have yet to be approached. The extents to which regional identities were recognised on the ground during the Neolithic and the mechanisms through which this identification operated are only now beginning to be addressed. Moving towards smaller scales allows for an appreciation of the inter-personal level at which the Mesolithic-Neolithic transition took place and invites a closer investigation of the ways in which societal change was meaningful to the communities themselves. The first group of papers illustrates that regional studies do not just add more detail to the picture of the beginning of the LBK, but allow for more nuanced reworking of our models, permitting consideration of the different scales at which early Neolithic communities lived.

This is exemplified by the two contrasting papers with which this volume begins. They show that even in well-studied regions there is scope for different conclusions. In the first paper, Amkreutz *et al.* test the various general models that have been suggested for the Mesolithic-Neolithic transition against the regional sequence in the Lower Rhine area. By comparing the range of archaeological materials found throughout the Limburg and Hainault, Amkreutz *et al.* demonstrate that the arrival of the LBK inspired a mixture of different forms of contact or styles of communication between foragers and farmers. These varied responses to the arrival of the Neolithic are not apparent when a broad, top down approach is taken, as the subtle variations in both LBK sites and Mesolithic occupations remain largely invisible. Amkreutz *et al.* also explore the ongoing debates around the Limburg and La Hoguette ceramic styles and LBK projectile points. Rather than looking at material remains as passive identifiers of the presence of a particular group in this region, the authors seek to invoke contexts in which contact took place, for instance when searching for raw materials or as part of transhumance.

The second paper explores a neighbouring region to those discussed by Amkreutz *et al.* and reaches some very different conclusions. Lodewijckx presents evidence for the indigenous groups in the region adopting the LBK life-style, a process that may not have been particularly peaceful (see also Keeley 1998; Keeley and Cahen 1989). This paper demonstrates the continued need to explore the non-LBK groups present at the beginning of the Neolithic in central Europe and the ceramic forms they may have produced. Lodewijckx asks whether the rigid distinction assumed between Limburg-style pottery and LBK wares is consistent through time, suggesting that their different origins did not prevent the groups that produced these wares from sharing ideas and techniques. With Amkreutz *et al.*, he stresses the need for further research into the actual form contact between foragers and farmers took, whether co-operative or competitive, and the context in which groups with different modes of life met and shared knowledge. By

juxtaposing these two papers we throw open the question about the relative merits of current approaches. Engaging with the very local scale leads to different conclusions, but is there still room for convergence, or are differences irreconcilable? What is the role of larger-scale models in a research trend that aims to write a detailed biography for each site or region?

Regional transitions are also of interest to Olga Larina in her exploration of the early LBK groups on the extreme eastern periphery of the LBK. Material on this region is not widely published in western Europe (but see e.g. Dergachev *et al.* 1991), and it hence plays a less prominent role in discussions of the LBK than is warranted by the rich remains it yields. Divided from the rest of the LBK by the Carpathian Mountains, the area discussed in this contribution is characterised by its long-lasting and varied interplay between the cultural traditions of indigenous populations and various newcomers, of which the LBK is only one – and not the earliest – element. The result is an unstable situation of acculturation and admixture in material culture, with the eastern LBK presenting a number of variations compared to material from further west. Site location can form an important aspect in the deciphering of this cultural mosaic. Larina suggests that pioneer LBK groups created outposts which were then expanded as other colonising LBK groups followed. This raises interesting questions about what inspired colonisation and the subsequent choice of settlement location. The environmental context seems to have been significant throughout the LBK distribution, with communities showing a notable preference for loess soils, and this is also the case on its eastern periphery. Larina argues that the agricultural basis for the LBK economy was fundamental to the selection of particular regions for colonisation. The next challenge is to reconstruct the role of certain landscapes in LBK worldviews, as opposed to simple economics.

Joanna Pyzel considers the significance of settlement patterns in a region without loess soils, exploring the arrival and subsequent developments of the LBK in Kuyavia, central Poland. She stresses the durability and stability of LBK settlements and argues that the application of core/periphery models is not appropriate to the LBK. Rather than seeing Kuyavia as an outlier to the events in central Europe, Pyzel demonstrates that the communities in this region develop at their own rhythm. This brings in broader questions of how we can identify LBK regional groups and whether these patterns had meaning to the groups themselves. The continuity between the LBK and post-LBK communities in this region is marked, even though the ensuing TRB culture demonstrates clear contrasts to the post-LBK developments elsewhere. Pyzel's paper allows a reconsideration of both the Mesolithic-Neolithic and the early-middle Neolithic transitions, moving away from monolithic notions of the LBK towards understanding different scales of community during this period and how these influenced the nature and extent of observable change.

Landscapes and Networks

Varied scales of community remain a significant theme for the following papers, a number of which focus on the landscapes and networks through which LBK communities effected material and social exchanges. Identity is a mediating facet of community life; it allows individuals and groups to understand their place in the

wider worlds in which they live (Amit 2002). It is hence crucial to explore how communities emerged and were tied together and into their environments and to consider the different scales of identity through which LBK communities organised themselves. The environmental and social landscapes were fundamental to the choices early Neolithic communities made about site location, economic exchanges and farming practices, as Larina also argues, but this was played out in different ways across the LBK. This set of papers explores how regional identities may have been constructed, but the authors also consider the individual or small group identities that may have been experienced on a settlement level.

The production, use and exchange of LBK adzes are often related to models of social hierarchy and male identity. In contrast, Ramminger focuses on adze exchange as part of a regional, rather than individual, construction of identity. She uses new petrographic analyses of adzes from Hesse, central Germany, to establish their place of origin. The results demonstrate that adzes were preferentially produced on non-local raw materials from the Bohemian Isera Mountains, despite the availability of suitable rocks closer at hand. Exchanges can express and create group affinities, and the stability of adze exchange networks leads Ramminger to suggest that the sourcing and movement of adzes helped to stabilize regional relations. Material objects do not passively reflect social identities but are part of the means by which they are affected and hence subject to modification and active manipulation. Does the increased regionalisation in raw material networks encountered during the late LBK relate to the strategic use of exchange to re-negotiate the scales at which identities are experienced?

Moving to the scale of inter-settlement relations, Claßen applies the 'Social Network Analysis' method to raw material exchange, settlement patterns and pottery from the Rhineland. He focuses on settlements as the social actors of LBK networks, which allows an interpretation of the data from a multi-scale and -temporal perspective. Strong conformity at the beginning of the LBK is followed by a decrease in the size of social units towards its end. The analysis shows that the decrease in the scale of social relationships may have had its origins in both the breakdown of kinship ties and long-distance exchanges. This illustrates that the boundaries between settlement groups and regional communities were not fixed, but fairly fluid, impacting on the social structures of the LBK and fundamentally changing the scale on which it was organised.

Bedault's contribution also takes a regional approach, focusing on the changing exploitation of domestic animals in the Paris Basin, particularly during the post-LBK Villeneuve-Saint-Germain culture. She argues that there is no geographical basis for the variations in the number or species of animals bred throughout the region, suggesting there may have been chronological and social reasons for the patterns found in the faunal assemblages. Bedault also questions the significance of the context in which these assemblages are found, stressing the need to consider the circumstances of deposition and hence exactly what the samples are representative of. This raises questions concerning the relationships that existed between individual houses and the roles animals played in the construction of LBK and post-LBK identities.

These ideas are developed by the following paper, in which Bickle re-considers the environmental landscape in which LBK communities constructed settlements and moved with their animals. Although beginning with an explicitly

phenomenological perspective, this contribution develops these philosophies to encompass performative theories which allow the tasks in the landscape to be considered as constructive of social relations. Thus, it argues that rather than being passive demonstrations of social hierarchy or identity, hunting and herding were involved in creating different scales of community and household relationships. Hunting offers an arena for the creation of more intimate and smaller-scale relationships, while the practices of herding were caught up in the social networks that stretched beyond the immediate settlement. It can be suggested that these different scales of social interaction with the broader community were also played out at the household level, as it appears that households were engaging in both hunting and herding to different extents.

These tasks and activities will have taken groups of people away from the settlement at particular times during the year, perhaps varying the size of the community and household. Knipper uses strontium and oxygen isotope analysis of human and cattle teeth to reconsider the extent of sedentism and mobility in the LBK. Isotope studies have long been associated with the attempt to investigate the beginning of the LBK (Bentley *et al.* 2002; Price *et al.* 2001; Bickle and Hofmann 2007), but in this paper Knipper argues that this method is far more productive when used to investigate land-use and husbandry practices. The data realised for southwest Germany demonstrates that mobility remains a significant aspect of LBK daily life. It also goes some way in showing the heterogeneous nature of that mobility, varying across an individual's life and between people.

Together, these papers take us beyond investigating single scales of social interaction and identity. We can now begin to appreciate the overlapping contexts in which the wider LBK community was drawn together, whether through the exchange of prestigious raw materials, routine transmission of pottery designs or in the daily round of moving with animals.

Sites and materials

The final set of papers take a single site or a geographically delimited group of sites as their starting point to reflect on wider issues of identity and social interaction. Oliver Rück's paper on settlement structure in the Rhineland re-visits some well-covered ground, but comes to provocative new conclusions which challenge received wisdom on various scores. Most fundamentally, he disputes the one-generation use-life of the LBK house. This has far-reaching repercussions for population size at any one point, but also suggests a planned settlement layout for many sites and questions the independence of 'wards' and their primacy in our social models. On the other hand, a longer use-life for individual houses could enhance the sense of rootedness and traditions experienced by its inhabitants. Rück suggests an open, raised house platform at the southeastern end, which has implications for privacy, as well as for the spatial structuring and organisation of everyday tasks. Although not all issues, for instance the relative dating of houses, are addressed to the necessary level of detail, Rück's research is a first step in reassessing the nature and importance of the settlement community, as well as the central role of the house in LBK societies. These are engaging questions for further research, and re-open the debate on issues all too often taken for granted.

Pechtl's paper also questions the house as a self-explanatory and somehow

isolated building block for social life, but he achieves this by comparing the social role and impact of exceptionally long houses and enclosures. Both can be classified as monumental architectural statements, but are generally treated separately: the size and/or complexity of houses is regarded as a matter of competition between households, and thus discussed at the level of individual sites (e.g. van de Velde 1990). Enclosures, on the other hand, are often categorised as projects in which the whole community is involved and as having implications for a site's status (e.g. Saile and Posselt 2004; Zimmerman 1995). However, as Pechtl shows for Lower Bavaria, the distribution of these kinds of architecture is mutually exclusive at a micro-regional scale, and this can be traced for other geographical areas. He raises the question of whether this implies different levels of social integration and conception of prestige even over short distances. Although the ultimate reasons for these differences remain open, this pattern characterises the LBK as a socially varied phenomenon within which settlement communities could selectively draw on and reinterpret a shared material repertoire.

In contrast, the site at Herxheim in the Rhineland-Palatinate, presented by Zeeb-Lanz *et al.*, raises issues of both the treatment of the individual body and the nature and extent of inter-regional networks. The deliberate fragmentation of at least 450 individuals and their deposition alongside animal bone, stone tools and pottery in discrete 'complexes' or assemblages undoubtedly have a ritual overtone. The recutting of the ditch segments in which these deposits took place gives some scope for time depth, but the absolute duration of the practice is as yet unclear—it seems to commence late in the settlement sequence at the site. A closer investigation of the material culture present here suggests that Herxheim formed a centre for a wider surrounding area. Potentially, human remains and other materials were curated and transported over long distances to be deposited here.

The Herxheim site also contributes to discussions concerning the end of the LBK, which is replaced by a series of regional culture groupings at the beginning of the 5th millennium. In the light of massacre sites and evidence for climatic deterioration (see above), Herxheim has been interpreted as a place where social outcasts, such as witches, were ritually punished by an increasingly embattled community ever more concerned with maintaining and defining its social borders under the onslaught of new pressures and ideas (Gronenborn 2006). However, the sheer number of people deposited, the manner in which this was achieved and the wide-ranging regional links evidenced here at least strongly relativise such a view – indeed, long-range networks seem to be active and celebrated, and it must be shown whether this really is the exclusive result of a perceived threat.

It is also possible to fit the site into a wider narrative on the treatment of the human body, especially the significance of its breakdown and admixture with animal bones and objects. Much research is still needed on the diversity of LBK funerary treatments, their change through time and their potential for investigating issues of personhood, identity and the body (see Jones 2005; Hofmann and Whittle 2008), but there are indications that the trend through time is towards an increased prominence of practices stressing fragmentation (Hofmann 2007).

Hofmann's paper also tackles issues of variability in funerary rites, but by comparing cemetery and settlement burials. Trying to overcome the overly rigid separation between these categories raises questions of the interplay between

shared ideas of appropriateness on the one hand, for instance related to the different treatment of age or sex groups, and on the other hand the creative manipulation of such ideas in the course of individual rites. A burial creates an image of the deceased for the mourners to remember, but it is an image dynamically built up in the course of a performance. In this way, shared ideas, local traditions and intimate and personal factors are interleaved. Settlement and cemetery burials are thus not simply static markers of differential socio-economic status. Instead, variations between them can be tied into the creation and maintenance of identities and networks at various social and temporal scales.

Finally, Rauba's contribution elucidates the technological choices of LBK potters in southern Poland. She has succeeded in identifying bone as a recurrent, deliberate inclusion in pottery fabrics. This is in contrast to the prevailing idea that earliest LBK and later coarse ware vessels were tempered with plant matter, while later fine ware was mostly mineral tempered (Engelbrecht and Lüning 2005; Franklin 1998). Bone as a technological choice is interesting, because it is also found in La Hoguette vessels in western Germany, eastern France and the Benelux countries. This pottery is often said to be the product of indigenous hunter-gatherer groups who had adopted some elements of a Neolithic lifestyle prior to the arrival of the LBK.

Whether or not the use of bone temper in southern Poland has a similar root, its presence represents a consistent choice repeated by potters on a routine level. Sommer (2001) has recently argued for the existence of strict rules regarding pottery production and especially decoration in the earliest phase of the LBK, rules which were later on relaxed. But by turning our attention to the production process, we can incorporate bodily routines and technological variation alongside the more immediately visible elements of decoration. Could this be a subtle way to express a regional or minority identity within the wider LBK framework? Or were such practices the result of localised networks of learning and transmission, rarely explicitly realised or questioned? Rauba's work opens up interesting questions of the importance of routine technological choices in the reproduction of identities at various scales and their perpetuation over time (see also Franklin 1998; papers in Lemonnier 1993).

Conclusion

This volume is only a first step towards a more multi-scalar approach to LBK identity. As well as addressing issues relevant to a particular category of material or a specific region, the contributions collected here can be read as invitations to further explore the interconnections between individuals, households, settlements and regions. These identities are not static and clearly defined, but are fluid and merge into each other, cross-cutting and problematising established archaeological categories such as body/person, house, site, region and culture. As the papers demonstrate, we are already some way to understanding the detail of regional and site contexts in which LBK identities were constructed, reconstructed and lived out. However, while debates around social structure, identity and exchange are well established in the LBK literature, bridging the gap between the various approaches remains problematic.

Whittle's thoughtful concluding remarks also remind us that, in spite of the

achievements of the last few decades, much else remains to be accomplished to drive LBK studies forward. Most importantly, he points to whole sets of issues, both methodological and interpretive, which we have hardly begun to tackle. Why, for example, do LBK worldviews and values form such a negligible part of our investigations? Is it because we implicitly assume them to be static geographically and chronologically? And how certain can we be of our chronological models, on which so much interpretation ultimately rests? By marginalising some core issues at the expense of well-trodden lines of investigation, a certain image of the LBK has been perpetuated and basic assumptions about the nature of this phenomenon have been left unchallenged.

There is, then, much more work ahead of us. Nevertheless, we hope that placing contrasting methodologies and different approaches within the same collection has succeeded in drawing out some of the cross-cutting concerns which unite LBK studies in their different regional research contexts and has gone some way in opening up debate. The breadth of the research presented here leaves us optimistic that international debate remains central to the development of LBK archaeologies. Divisions within our discipline remain, but both more empirically oriented and more interpretative archaeologies can only benefit from intensive dialogue with each other.

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Diverging trajectories? Forager-farmer interaction in the southern part of the Lower Rhine area and the applicability of contact models

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Introduction

In the study of the Neolithisation process, the archaeological correlates for the actual transition to agriculture often contrast with the independently conceived and ethnographically inspired models explaining it. Rather than forming the basis for a contextual analysis of the transition within a certain region, archaeological data has increasingly been moulded to fit these models and the different stages or variations within them. Recently, however, there has been an increasing awareness that matters are more complicated. Various taphonomic issues were addressed by Rowley-Conwy (2004), while others (Thomas 1996; Tringham 2000) argued that the process of Neolithisation was characterised by different temporalities of its constituent elements and by local narratives of change (Barrett 2000; Dobres and Robb 2000; Sommer 2001; Whittle 2003). It formed a true ‘mosaic’ of spatio-temporally unique and independent developments. While this certainly does not deem the existing models outdated, it does argue that they should be used in a contextual perspective and be based on actual archaeology.

This paper sets out to contrast models and archaeological data. Several models are presented and followed by an analysis of typical distorting factors with respect to their use. The archaeological evidence in the form of contact finds and distribution patterns is presented for two separate regions, Dutch Limburg and the Hainault area. The focus lies on the initial phase of the Neolithisation process and the interaction between the Linearbandkeramik (LBK) and late Mesolithic hunter-gatherers. Finally, the models are contrasted with the archaeological information available.

Modelling contact – endless variability?

Over the past decades, the interaction between foragers and farmers has given rise to many publications concerning its nature and development and its eventual outcome for both groups involved. The models presented in these publications are

often rooted in archaeological patterning (e.g. Keeley and Cahen 1989; Verhart 2000; Zvelebil and Rowley-Conwy 1984), ecological theory (Gregg 1988) or ethnographic accounts of contact between foragers and farmers (e.g. Dennell 1985; Verhart 2000). Although these constructions often provide interesting frameworks for what might have happened during and evolved out of forager-farmer interaction, they often do not offer tools or perspectives on how to interpret the scanty evidence available.

For the study of primary and evolved contact situations in the northwestern areas of the LBK, such an inferential frame of reference for interpreting the material derivatives of interaction would be very useful. Below, the models proposed by Zvelebil and Rowley-Conwy (1984), Dennell (1985), Gregg (1988) and Verhart (2000) are briefly discussed in order to provide some insight into their scope, depth and background. These models converge on many different aspects, but are in general informative on a different level (Table 1).

The ‘availability model’ was first presented by Zvelebil and Rowley-Conwy in 1984 and was elaborated upon in numerous later publications by various authors (e.g. Zvelebil 1986; 1998; Louwe Kooijmans 1998; Price 2000). The model is more descriptive than explanatory and its merits lie primarily in that it offers a heuristic device to consider the factor of time in a regional approach to the transition to agriculture (Zvelebil 2000). It distinguishes an *availability phase*, when foragers and farmers developed contacts but remained culturally and economically independent; a *substitution phase*, with incorporation of 5 to 50% of domesticates into the hunter-gatherer economy (Zvelebil 1986) or the immigration of farmers into hunter-gatherer territory; and a *consolidation phase* as the first phase of a predominantly Neolithic economy in which hunting and gathering are no longer important for food supply and the organisation of labour.

Table 1. Models of Neolithisation referred to in the text.

Model	time/character	space/frontier	contact/frontier	interaction
Zvelebil and Rowley-Conwy 1984	availability	mobile to static	0–5% independent	beneficial, exchange
	substitution	static/mobile	5–50% incorporation	competition, acquisition
	consolidation	mobile	50% frontier move	consolidation
Dennell 1985	(availability/substitution)	mobile	open	beneficial, exchange
		mobile	closed	violence/assimilation
	(availability)	static	open	beneficial
		static	closed	animosity
Verhart 2000	first contact	mobile	open	social, exchange
	second contact	mobile	open	option 1: dependence
		static/mobile	open	option 2: symbiotic
		static	closed	option 3: independence
Gregg 1988	direct competition	static	closed	territoriality/aggression
	indirect competition	mobile	open/closed	negative/alteration
	direct mutualism	mobile	open	exchange/cooperation
	indirect mutualism	static	closed	beneficial conditions
	facultative mutualism	static/mobile	open/closed	optional
	obligatory mutualism	mobile	open	necessary for survival

At a general level, the availability model emphasises the phased character of the

transition to agriculture but does not explicitly spell out the nature of the relationship between foragers and farming communities. It is this relationship that forms the focus of Dennell's frontier model (Dennell 1985; Zvevibel 1986). Here, a distinction is made between mobile and static frontiers. In the case of a *mobile frontier*, agriculture expands across a certain region through various mechanisms (Dennell 1985, 121–32): hunter-gatherer immigration into farmer settlements; hunter-gatherer acquisition of farming knowledge, skill and techniques; natural resource migration; and colonization without hunter-gatherer participation. Mobile frontiers in fact correspond to the sequence from availability to consolidation within a particular region, as detailed above. Dennell (1985) also defines *static frontiers*. Open static frontiers contrast with closed static frontiers in that they involve the exchange of items and knowledge. Static frontiers correspond to a long and unchanging availability phase within particular regions.

Building upon the open and closed aspects of the frontier model proposed by Dennell (1985), one of the authors introduced a two-stage model for the introduction of an agrarian economy in the Netherlands, based on a variety of ethnographic sources and developed from a social perspective (Verhart 2000). The two stages can blend into each other and sometimes only the first or second stage is present. The first often short stage of contact is characterized as a period of intense amazement and confusion, mainly affecting the social subsystem. Exchange in this stage involves hunter-gatherer acquisition of items that can be used in their prestige system, in particular artefacts, which are exchanged for food, sexual favours and useful raw materials. The second stage involves three possible developments that may blend to some degree: *dependence*, with the integration and (partial) acculturation of native hunter-gatherers; *symbiosis*; or *independence*, with an attitude of avoidance towards continued interaction.

From an ecological perspective, Gregg (1988) arrives at similar options, which can be correlated with Verhart's second stage or Dennell's open and closed frontiers. Her model distinguishes between antagonistic *competition* and cooperative *mutualism*. Competition exists when two or more populations use a limited resource. The nature of competition can be direct, entailing aggression, or indirect, if one population uses or alters a resource thereby reducing its availability to another. Mutualism occurs when two populations exchange goods or services to cooperatively exploit a range of resources (Gregg 1988, 42). It comprises many relationships depending on the degree to which people interact, whether or not it is a prerequisite for continued existence, the periodicity of interaction and the extent of reciprocal specialization. Direct mutualism involves contact, while indirect mutualism only implies the creation of beneficial conditions. The interaction can furthermore be *obligatory* or *facultative*. The former is necessary for survival, while the latter does not hinder it.

Each model stresses a different reality of forager-farmer interaction, but there is also convergence on some critical points, accentuating a certain similarity in the development of contact and exchange and indicating a similar array of options (Table 1).

Problems of pluriformity

The models discussed above cover a broad range of contact situations and

interaction. Some situations incorporate antagonistic aspects, while others stress cooperation and mutual benefits. Their common denominator is that all, to a certain extent, study the interaction between the LBK and indigenous foragers. In the context of contact finds and spatial patterning, many different scenarios could underlie the documented archaeological correlates. Gronenborn (2004) aptly expresses this in his comparison of the advent of the LBK and the Bantu expansion in southern Africa many millennia later. The southward expansion of Bantu-speaking migrants involved the migration of domesticated sheep, cattle and pottery. The local population subsequently adopted elements of this package, which resulted in a rich diversity of groups: indigenous hunter-gatherers in the west and central arid regions, some of which produced their own pottery; as well as pastoralists herding cattle, sheep and goat further south and southwest. All of these groups were in direct contact with Bantu farmers. From a classificatory point of view, full-scale farmers thus interacted with pottery-using herders, hunter-gatherers and so-called *chasseurs ceramisées* (Gronenborn 2004, 234, 247). Various interaction processes were documented, including full- and small-scale migration, diffusion, interaction, acculturation and assimilation (Gronenborn 2004).

Such a rich constellation of groups and processes might, to a certain extent, also be assumed for the early Neolithic of northwestern Europe, although we lack the convenience of a rich ethnohistoric background. The much-debated advent and origin of the LBK (see Zvelebil 2004) already presupposes the presence of multiple actors. This aside, the presence of various groups of late Mesolithic hunter-gatherers, some of which evolve into *chasseurs ceramisées* (e.g. Swifterbant; see Raemaekers 1999; Louwe Kooijmans 2001), forms the background for a still hardly understood period of interaction and transition. Possibly related to this interaction are the phenomena of La Hoguette (LH) and Limburg (LB) pottery. We are potentially dealing with fully-fledged farmers, hunter-gatherers with and without pottery, as well as, hypothetically in the case of La Hoguette, pastoralists with pottery (Kalis *et al.* 2001). This could involve the processes of migration, interaction, acculturation, assimilation and diffusion.

The problem with this situation is that it involves many different possible scenarios for interaction, which are unfortunately only informative when they result in preserved material remains and/or patterning. Furthermore, archaeological correlates may not be unique to one type of interaction. Three factors are of special importance and deserve to be taken into serious consideration in any study of early Neolithic forager-farmer interaction: taphonomy; multiple possible interpretations for archaeological patterns; and spatio-temporal considerations.

Taphonomy

One of the most important factors distorting our perspective on Mesolithic-Neolithic interaction is taphonomy. This issue has recently been addressed for the British Isles by Rowley-Conwy (2004). Only a small part of contact and exchange will materialise archaeologically and forager-farmer interaction is often characterised by a general disparity in the kinds of items exchanged (Dennell 1985; Gregg 1988; Verhart 2000). The hypothetical model of forager-farmer exchange in the Baltic (see Zvelebil 1998, fig. 1.5) is a good example. Many of the

items or objects hunter-gatherers brought into the interaction, such as forest products, fur, skins, seal fat, amber, raw materials or honey, stand either no chance of survival or cannot be identified as of 'Mesolithic origin' (see also Verhart 2000). This is exacerbated by the idea that objects of indigenous groups were often regarded as inferior (see Verhart 2000; 2003). Similarly, other evidence for interaction, for instance in the form of DNA (Richards 2003) or stable isotopes (cf. Price *et al.* 2001), only stands a chance of survival under extremely good circumstances. The loess and sandy upland environment of the study area is often characterised by decalcified and acidic conditions that reduce evidence for contact to a purely lithic endeavour with occasional finds of pottery. It should therefore be stressed that the available evidence for interaction is merely the taphonomic residue of behaviourally variable contact that in some cases will have led to, mostly unintentional, deposition of objects. The deposits will often even lack an informative spatio-temporal context.

Objects, people, ideas

The next factor is schematically depicted in Figure 1 and involves the possibility for multiple interpretations of the archaeological correlates of exchange. This especially involves objects, often LBK artefacts that have been found beyond LBK areas. Regular finds of LBK adzes on the upland coversand landscape, north of the loess-based settlement clusters, are an example. These finds can be interpreted according to very divergent scenarios. One explanation is to assume the object moved away from the LBK settlement cluster as the consequence of interaction and exchange (see Verhart 2000; in prep. a). Ideally, this could involve some form of Mesolithic context, for instance in the form of associated microliths. Another option would be to assume that the object was carried by LBK farmers until its deposition. It might have been taken along on an expedition or herding trek. For the LBK settlement cluster of the Graetheide, it is often assumed that LBK objects found up to 20 km north of the loess zone can be associated with LBK forays, expeditions and other off-site activities (e.g. Amkreutz forthcoming; Bakels 1978; 1982; Louwe Kooijmans 1998; Verhart 2000; in prep. a). In this case, it would not be an archaeological correlate for contact.

It is difficult, however, to know where to draw the line. Adzes have been found up to more than 100 km from the nearest known settlement site, and at the late Mesolithic site of Hardinxveld-Giessendam Polderweg in the Rhine-Meuse delta, an LBK point was found in a stratum dating to c. 5300 cal BC (Louwe Kooijmans 2003). These do form examples of interaction, but where do expeditions end? What is the influence of down-the-line contact? How can we define raids or scavenging? The situation becomes even less clear-cut when, for example, projectile points or ceramics are involved, since there is a distinct possibility these might have been produced or imitated locally as a result of acculturation. At the late Mesolithic site of Weelde-Paardsdrank for example, several points of LBK affinity were found amidst concentrations of Mesolithic settlement debris (Huyge and Vermeersch 1982). Limburg ware, found both within and beyond LBK settlements, has for example rather different decorative schemes and temper compared to LBK fine ware and, similarly, the existence of non-conformist LBK ware on LBK settlements might be the result of forager women marrying into

farmer society (Van de Velde 2008). We are thus faced with several scenarios, most of which cannot be completely excluded based on the nature of the evidence available.

Spatio-temporal considerations

A final issue influencing our understanding of forager-farmer interaction is of a spatio-temporal nature. Often, from a neo-evolutionary perspective contact between foragers and farmers is described as unilinear. Foragers are clearly involved in a process of change. This is aptly expressed by the different stages defined by some of the authors above. While this might be useful in large-scale modelling of the transition to agriculture, it does not do justice to the actual historicity of the Neolithisation process and the role of forager-farmer interaction therein. As was argued above, the transition to agriculture can be considered a true mosaic (cf. Tringham 2000), consisting of a multitude of unique inter- and intra-regional developments. Furthermore, there are quite a number of ethnographically documented cases that indicate a considerable flexibility in the adoption of agriculture. There was the option of reversibility and falling back upon a hunter-gatherer existence, of trial phases and abandoning of the new (e.g. Habu 2002; Layton 1999; Layton *et al.* 1991; Rowley-Conwy 2001). This stresses the many-sidedness of contact situations. As demonstrated ethnographically, hostile, friendly and neutral relations exist with different neighbours and frequently change in character (Godelier 1986; Kelly 1993; Chagnon 1997).

Many of the aforementioned models pragmatically neglect this variability in absence of the resolution to document it. However, it is important that research takes place on the scale of detailed micro-regional studies (see Ammerman and Biagi 2003). Only these studies can potentially reach a resolution that goes beyond generalist hypotheses about the character of interaction and incorporates locally specific variables and archaeological correlates in order to document both the variability and nature of the existent contact situations.

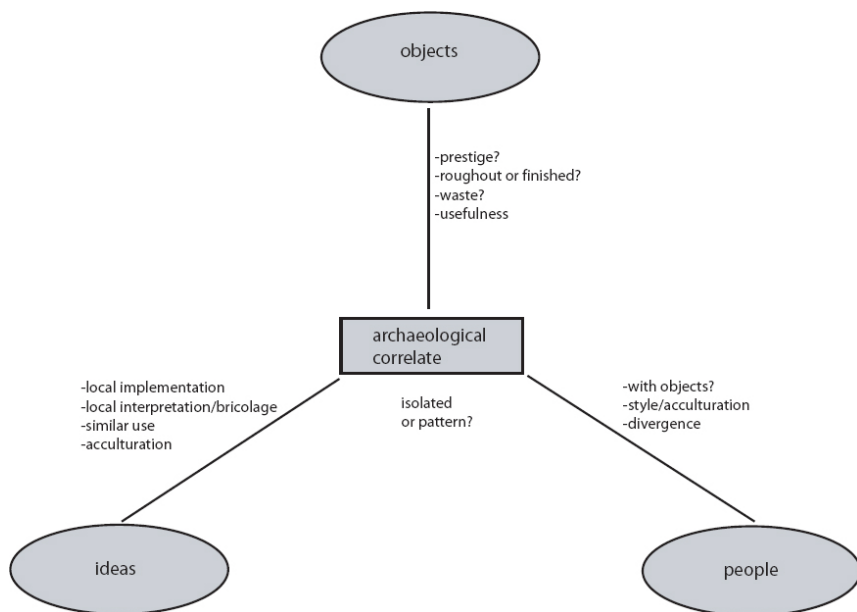


Figure 1. Schematic depiction of hypothetical explanations for correlates of exchange. Related points of attention have been placed along the axes.

Forager-farmer interaction in two adjacent regions

The Neolithisation process in the southern part of the Lower Rhine Area

The process of Neolithisation in the southern part of the Lower Rhine Area (LRA), which corresponds to the study region of the Low Countries, northwest of the Ardennes plateau, starts with the arrival of LBK farmers around 5300 cal BC (e.g. Louwe Kooijmans 1998). They settle the loess soils, grouped in several settlement clusters, the westernmost and most remote of which is located in the area of the sources of the Dendre river (see Jadin and Hauzeur 2003b). Evidence for late Mesolithic settlement nearby is mainly known from the adjacent coversand landscape. The near absence of hunter-gatherer traces on the loess reflects the low intensity of exploitation in this region, but can also partially be related to the particular taphonomy (see Vanmontfort 2008). Finds of Limburg ware both within and outside LBK settlement contexts, as well as locations yielding sherds of La Hogue pottery, indicate the presence of other ceramic groups. In the case of the La Hogue group these might even have been anterior to LBK occupation (Louwe Kooijmans 1998).

Around 4900 cal BC, the LBK occupation of the area ends rather abruptly. A strong increase in the number and size of settlements was documented for the last LBK phases in the Graetheide cluster (see Bakels 1982). Subsequent evidence for occupation is meagre and, apart from stray finds, involves settlements of the *Groupe de Blicquy* in the Dendre cluster and the Hesbaye region and, somewhat later, a single Rössen settlement near Maastricht (Crombé and Vanmontfort 2007; Louwe Kooijmans 1998). Due to lack of chronological resolution, little is known

about possible hunter-gatherers still inhabiting the area. The appearance of the local variant of the Michelsberg culture around 4300 cal BC is interpreted as a convergence of local elements that had evolved out of the Danubian Neolithic with the local substratum of hunter-gatherers (Crombé and Vanmontfort 2007; Vanmontfort 2004).

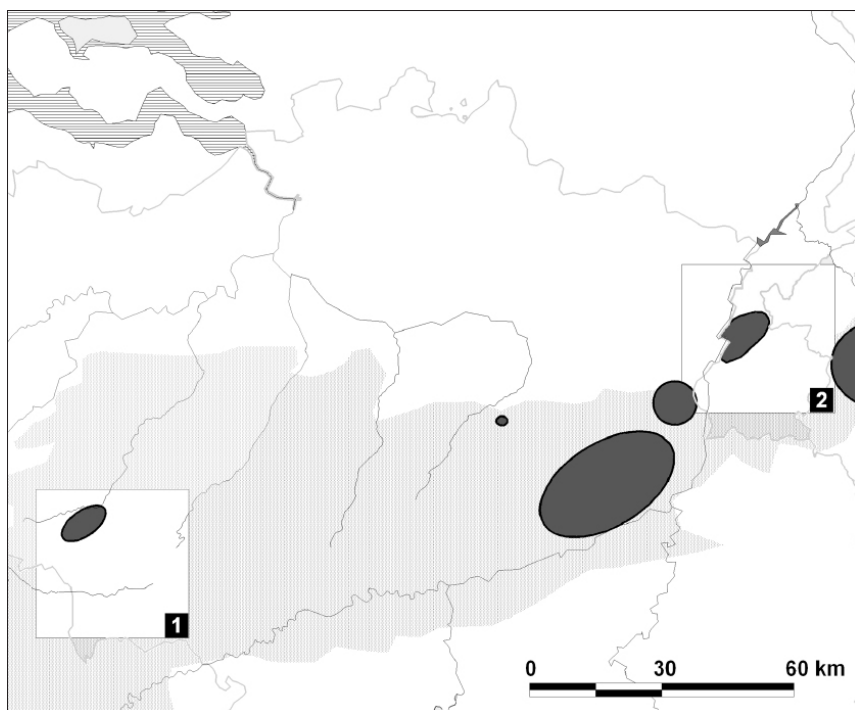


Figure 2. Map depicting the Limburg (2) and Hainault (1) study regions, the extent of the loess and the distribution of LBK settlements.

In this study, we will deal with the first part of the Neolithisation process in two regions of LBK occupation and in particular with the evidence for forager-farmer interaction. The many difficulties outlined above have left us with mainly two lines of evidence: contact finds and settlement patterns.

Physiography of the study regions

Limburg

The Limburg region is located in the southernmost part of the Netherlands, bordered by Belgium to the west and Germany to the east (Figure 2). Geographically it can be subdivided into three different zones, ranging from the southern part of Dutch Limburg along the Meuse to the central river district further north. The first zone is located south of the Graetheide plateau and consists of Cretaceous limestone outcrops. A combination of fluvial action and erosion of

the loess led to a hilly and dissected landscape varying between 60 and 320 m above Dutch ordnance datum (Berendsen 1997, 10–21). North of this zone another type of landscape is encountered, characterised by a thick loess cover. The relief in this area coincides with three terraces of the Meuse. The spacious middle terrace formed the main focus for LBK habitation because of the even terrain, the loess and the presence of water. Lately, however, LBK settlements have also been discovered on the upper terrace and on the lower terrace next to the Meuse (for an overview see Amkreutz forthcoming). A dense homogeneous lime and oak forest covered both these zones. In the Meuse Valley, riparian woodland existed with open patches consisting of herbs and grasses (Bakels 1978).

The third and last zone of the Limburg study region is the rather flat coversand landscape north of the Graetheide plateau. The micro-relief is formed by sand dunes and ridges, and many brooks and smaller streams drain the area to the Meuse. In contrast with the first two zones, vegetation in this area was of a more patchy nature relating to the presence of water in the form of streams or fens. Vegetation consisted of a forest with oak, birch, beech and alder in the wetter parts, as well as open spaces with shrubs, herbs and grasses (Berendsen 1997, 26–31).

Hainault

The Hainault study region is located in the western part of central Belgium (Figure 2). Based on its physiography, the region can be subdivided into two subzones. The northern part belongs to the Belgian loam region. The relief is softly undulating in the Dendre river source area and more dissected north of it. The soils developed within several meters of loess on top of a substrate of limited permeability and are predominantly typical luvisols. The vegetation on the loess plateaus during the Atlantic period mainly consisted of lime forest.

The southern part of the Hainault study region is dominated by the synclinal Haine river basin depression (Goossens 1983). This basin formed during Cretaceous and Eocene times and was filled with thick Quaternary deposits. Soil development in the loess mainly took place on top of a permeable substrate and on loamy sands and alluvial deposits in the centre of the river basin.

Mesolithic artefacts in LBK contexts

Unquestionable Mesolithic artefacts in LBK contexts are extremely rare. In the Limburg study region, only two sites with LBK pits containing Mesolithic microliths are known. A single LBK pit at the settlement of Geleen-Janskamperveld contained three Mesolithic points. One was a point with unretouched base (Van de Velde 2008). Two mistletoe points were found in a similar context at Elsloo (W. Hendrix pers. comm.). An LBK pit at Maastricht-Klinkers contained several pieces of Wommersom quartzite. This raw material was frequently used by late Mesolithic hunter-gatherer groups (Caspar 1984), but not by the LBK farmers. The presence of Wommersom artefacts is thus often related to hunter-gatherer activities. In the Hainault study region, the only occurrence of Mesolithic artefacts in an LBK context is a single mistletoe point in an LBK pit at Blicquy-Couture du Couvent (Constantin *et al.* 1991).

Mesolithic artefacts in LBK or Neolithic contexts are also rare in general, beyond the study regions discussed here. Few mistletoe points, trapezes and invasively

retouched points have been found in the LBK of the neighbouring Hesbaye settlement cluster (see Destexhe 1974–1976; Eloy 1947, 112; 1963, 11; Gob 1984; Jadin and Cahen 2003; Keeley 1992 and Table 2). Other Mesolithic lithic artefacts were found in a pit at Liège-Place St.-Lambert (Gob 1984). Wommersom quartzite has been documented in the LBK sites of the small Kleine Gete settlement cluster, where it represents 9–10% of the artefacts (Lodewijckx and Bakels 2000; this volume). Finally, it should be stated that many surface sites of the LBK also yield Mesolithic artefacts.

However, none of these occurrences form convincing evidence for interaction between foragers and farmers. The few microliths and other Mesolithic artefacts found in LBK pits could also be residual. As Van Assche (2005) rightly stresses, most of these microliths are typical for the earlier phases of the Mesolithic and thus pre-date LBK arrival in the area (also see Arts 1989; De Laet 1982, 207). This means that the few trapezes in these contexts also do not need to be contemporary with the LBK. The same is true for surface associations of material. The use of Wommersom quartzite on some LBK sites cannot prove forager-farmer interaction either. On most sites, the very few artefacts in this raw material are either undiagnostic or typically Mesolithic. In view of the palimpsest problem, they can thus also be residual. In the Kleine Gete LBK, more Wommersom quartzite was used for tool production, but unfortunately none of the artefacts are clearly Mesolithic or LBK (Lodewijckx and Bakels 2000). Even if they were part of the LBK tool production technology, however, they do not unequivocally imply hunter-gatherer or other autochthonous group interference (Vanmontfort 2007).

LBK artefacts beyond settlement clusters

LBK artefacts are often found beyond the settlement clusters identified thus far. In the Limburg area, these range from isolated occurrences of pottery, flint and adzes, over combinations of LBK artefacts to mixed assemblages combining LBK elements with, for example, Limburg pottery (Figure 3).

The loess-covered hills south and east of the Graetheide plateau yielded isolated adzes, points and other tools. Small grinding stones and pieces of hematite might also date to the early Neolithic, but are of course less diagnostic. Small concentrations of LBK artefacts are also documented in this area, for instance at Gulpen and Noorbeek-Noor (Amkreutz forthcoming). There are no convincing Mesolithic artefacts or sites, and the occurrences of LBK artefacts should thus be interpreted as remains of off-site activities within the home range (*sensu* Bakels 1978) of one of the LBK clusters. The LBK flint procurement site of Banholt forms a further line of evidence for these activities (Brounen and Peeters 2000/2001).

Table 2. Mesolithic artefacts in LBK contexts.

<i>site</i>	<i>artefact</i>	<i>context</i>	<i>references</i>
<i>Geleen-Janskamperveld</i>	3 Mesolithic points, including 1 point with unretouched base and 1 with inverse retouch	LBK pit	Van de Velde 2008
<i>Elsloo</i>	2 feuille de gui	LBK pit	Hendrix pers. comm.
<i>Maastricht-Klinkers</i>	pieces of Wommersom quartzite	LBK pit	De Warrimont 2003
<i>Blicquy-Couture du Couvent</i>	1 mistletoe point	LBK pit	Constantin <i>et al.</i> 1991
<i>Vaux-et-Borset</i>	feuille de gui	?	Eloy 1963,111
<i>Tilice-Flexhe-Slins</i>	feuille de gui	?	Eloy 1947, 212
<i>Verlaine-Sur les forts</i>	feuille de gui	?	Destexhe 1974–1976
<i>Darion-Colia</i>	2 points with invasive retouch; 2 trapezes, pieces of Wommersom quartzite	?	Jadin and Cahen 2003
<i>Oleye-Al Zepe</i>	3 points with invasive retouch; 1 trapeze	?	Jadin and Cahen 2003
<i>Liege PSL</i>	several Mesolithic artefacts	LBK pit	Gob 1984; Van Berg 1990; Keeley 1992

Considerably more LBK artefacts have been found in the coversand landscape north of the Graetheide cluster, including isolated finds, combinations of artefacts, multi-component sites and possible settlements. LBK artefact concentrations involve various combinations of LBK artefacts (adzes, points, pottery), sometimes in combination with Limburg pottery. Artefact quantities at these sites vary between a few objects to considerable concentrations. They are mostly found on the surface, which makes an unambiguous association of the artefacts impossible.

Generally no Mesolithic elements are reliably associated, which favours an explanation of these sites as serving a specialised function in an LBK context. The quantity of remains might determine the intensity or frequency of use as well as the level of *permanency* or consistent frequentation of these locations (see Louwe Kooijmans 1993). A good example of one of these sites off the loess is Echt-Annendaal-HVR 183 (Brounen 1985). Located on a terrace edge several kilometres north of the loess, this site yielded sherds of four different LBK vessels as well as of Limburg pottery. Furthermore, scrapers, blades and an arrowhead were found. Another such site was found near Koningsbosch on a patch of loamy sand. The artefacts at these locations are part of a wider distribution of LBK finds in a zone of up to 20 km north of the loess (Verhart 2000; in prep. a). Notably, this zone lacks substantial features or house plans (Van der Graaf 1987; Louwe Kooijmans 1998). With the exception of some locations (see above) most of these sites might be interpreted as belonging to LBK off-site activities such as transhumance. Sherds often date to the second phase of LBK occupation (see Brounen 1985; Van der Graaf 1987). This might be linked to a greater need for pasture to cope with the increase in settlements and population on the Graetheide plateau (Bakels 1982; Bogucki 1982). Exchange or interaction between foragers and farmers cannot be excluded, but the absence of reliable associations of Mesolithic and Neolithic remains makes this option less likely. Alongside the concentrations described

above, there are also other finds and combinations of finds. These range from the coversand area into and across the central river district.

Possible LBK settlements or combinations of LBK artefacts often occur in and directly north of the loess belt region. The other combinations shown in Table 3 are also found on the coversands and occasionally in the river district. Their wide-ranging spatial occurrence and occasional association with Limburg, La Hoguette or late Mesolithic cultural remains prevents a purely functional interpretation within an LBK context. A probable explanation is contact with Mesolithic hunter-gatherers (see Verhart 2000). This indigenous aspect could involve various processes of exchange and interaction (see above). The valued and costly adzes (Van de Velde 1990), or points as markers of cultural identity might have played a role in these contacts. The interpretation of this interaction is mainly based on the function and the association of the artefacts found (also see Van der Graaf 1987, 15), yet at the same time hampered by the fact they are not found in context, but on the surface. Further complicating factors are the interpretation of isolated and associated occurrences of Limburg pottery, La Hoguette and *Begleitkeramik* (BLH) and possible evidence of acculturation.

Also in Hainaut, several LBK traces have been documented beyond the Dendre source settlement cluster. Isolated adzes, arrowheads and very few potsherds have been found (Jadin and Hauzeur 2003a). Most of these finds are concentrated in the Haine river basin, approximately 20 km southeast of the LBK settlement cluster. In general, however, the density of LBK finds is much lower in this area. Contrary to the Limburg area, no concentrations of LBK artefacts have been reported to date.

Beyond the two study regions, similar patterns can be observed. Isolated occurrences characterise more or less the entire loess belt, with a concentration in southwestern Brabant (Jadin and Hauzeur 2003a). There is also a variety of isolated finds and combinations of finds in a zone stretching farther north of the loess belt, into and across the central river district. Apart from LBK artefacts, ceramics of Limburg, La Hoguette and *Begleitkeramik* of La Hoguette are also found. Table 3 gives an overview of the different combinations possible. It is apparent, however, that these finds concentrate on the eastern side of the map. LBK artefacts more than 30 km north of the Dendre source settlement cluster are rare. At least for a single LBK adze found on a Roman site near Ghent, it was concluded that it could also have travelled into this area in more recent times (Perdaen *et al.* 2006).

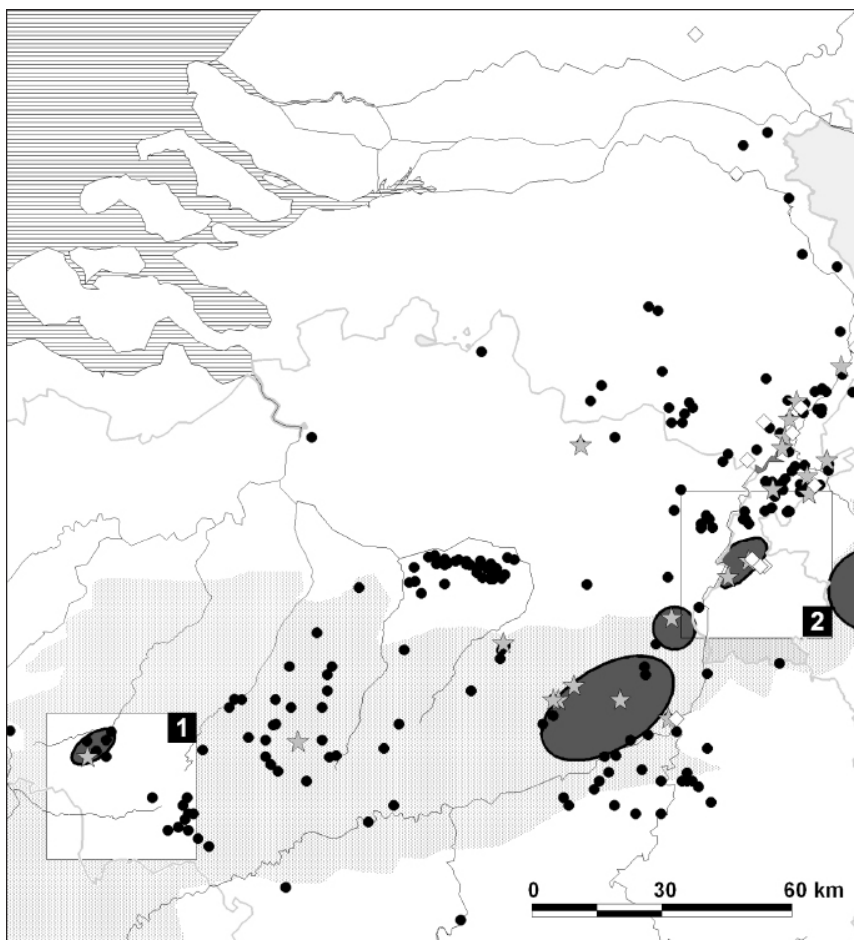


Figure 3. Early Neolithic artefacts on and beyond the loess region. Key: white lozenges: La Hoguette pottery; stars: Limburg pottery; dots: LBK finds beyond LBK settlement territory; hatched areas: LBK settlement clusters.

Table 3. Overview of combinations in evidence of possible contact. Scores in brackets indicate a questionable association.

	LBK point	LBK-like point	LBK adze	LBK pottery	LBK combi	LBK settlement	Mesolithic	isolated
<i>isolated</i>	+	+	+	+	+	+		
<i>Limburg pottery</i>				+	+	+	(+)	+
<i>La Hoguette</i>						+	(+)	+
<i>Begleitkeramik LH</i>			+				(+)	
<i>Mesolithic</i>	+	+	+	+		+		

To conclude, LBK remains have been found in a much larger region than that of the settlement clusters. Especially the loess belt region and a buffer zone of approximately 20 km have yielded such remains (Verhart 2000; in prep. a). It is likely that they represent another aspect of LBK exploitation and occupation of the LRA. Sites such as Banholt and Echt-Annendaal show this to be the case in the Limburg area, but the Haine river basin may also have been frequented in search of flint for tool production. Isolated artefacts found beyond this 20 km buffer zone are more likely to be the result of some sort of exchange with people occupying that region during the LBK occupation phase (Verhart 2000; in prep. a). It is clear, however, that these indications for exchange and interaction concentrate in the eastern part of the LRA.

Other early pottery traditions

Other ceramic groups include La Hoguette (LH) and *Begleitkeramik* of La Hoguette (BLH).

While both until now have not been found in the Hainault region, the Limburg area has yielded several sites with sherds of LH and BLH pottery (Figure 3). The first site with sherds of LH pottery was discovered on the upper terrace adjacent to the LBK settlement of Geleen (Van Berg 1987; Modderman 1987). This site also yielded BLH (Van Berg 1990, 1994). An LBK pit at the site of Geleen-Nijssenstraat yielded several La Hoguette sherds (Brounen and Vromen 1990, 36–8). The pit dated to phase IIc/d. Table 4 summarizes the finds so far.

It is noteworthy that this type of pottery spread considerably far north. The site of Ede-Frankeneng is located in the province of Gelderland across the central river district. Furthermore, it mostly concerns isolated surface finds of several sherds. During the small-scale excavations of Ede and Sweikhuizen, however, considerable amounts of clustered sherds, but no archaeological features, were discovered.

La Hoguette pottery might belong to an indigenous tradition of ceramic production contemporary with and perhaps even prior to the LBK (De Grooth 2005, 293; Gronenborn 1999, 184; Jeunesse 1994; Lüning *et al.* 1989). The faunal remains in several small trenches in Stuttgart-Bad Cannstatt suggest that there was a pastoral element within the subsistence of this group (Kalis *et al.* 2001). BLH was only recently defined by Jeunesse (1994, 15). It differs from LH in the absence of doubly indented rows of spatula impressions (Jeunesse 1994; Brounen 1999). Both types were found in sealed contexts on several occasions, and most probably are related to each other. Limburg pottery has been defined by Modderman (1974) on the basis of an isolated vessel found at Kesseleik, Limburg. This type of pottery was already known for several decades from its frequent occurrence in LBK settlements, for instance as Importgruppe I (Buttler and Haberey 1936). Most typically, sherds of Limburg pottery are associated with LBK material of the younger period (phase II *sensu* Modderman 1970) and despite the isolated occurrences mentioned, this frequent association seems to occur both on and off the loess (Brounen 1986, 41; Van der Graaf 1987). This was, for example, the case at HVR-183 (Brounen 1985), or, in an open context, at Horn-Lateraalkanaal (Modderman 1981). In addition, sherds of Limburg pottery are frequently found in pits of LBK settlements on the Graetheide plateau (Figure 3).

Table 4. Finds of La Hoguette and Begleitkeramik in the Netherlands.

Site	LH	BLH	N sherds	Context	reference
Stoeikhuizen	+	+	84/3	upper terrace, loess	Modderman 1987; Van Berg 1987; 1990
Geleen-Nijssenstraat	+		several	LBK pit, loess	Brounen and Vromen 1990
Posterholt		+	several	coversand	Verhart 2000
Ittervoort-Damszand	+		several	coversand	Brounen <i>et al.</i> in prep. a
Haalen-Broekweg		+	several	coversand	Bats <i>et al.</i> 2002
Kessel-Sjoppenaas		+	several	coversand	Brounen 1999, 61
Venlo-Ossenbergh		+	several	coversand	Brounen 1999; Verhart 2000
Gassel		+	several (+ LBK adze)	riverdune	Brounen and de Jong 1988
Ede Frankeneng	+	+	64+	depression, coversand dune	Brounen <i>et al.</i> in prep. b; Schut 1988

In Hainaut, Limburg pottery is abundant in the assemblage of the Aubechies-Coron Matton LBK site (Constantin *et al.* 1980), but has not been discovered beyond the LBK settlement cluster.

The problem with Limburg pottery still lies in its interpretation. Different scholars argue in favour of an indigenous development, based on divergences in technology and distribution (e.g. Louwe Kooijmans 1976; Constantin 1985; Van Berg 1990), a local development out of La Hoguette (Louwe Kooijmans 1998), or see Limburg ware as an element that should be interpreted within the LBK context (e.g. Constantin *et al.* forthcoming). Van de Velde (2008) argues that the hybrid character of Limburg vessels, incorporating both LBK and 'other' elements, might also relate to intermarriage and related derivative 'mixed' pottery traditions. Either way, an intrinsic and an acculturated perspective seem to point to important involvement of the LBK. It is notable that there is no closed association of Limburg pottery and Mesolithic flint as opposed to Limburg pottery and LBK artefacts (also see Van der Graaf 1987).

Unfortunately, it can only be concluded that the bearers of these indigenous pottery traditions and their link with indigenous or other groups remain elusive. Nevertheless, it should be borne in mind that they were present and perhaps played a role in forager-farmer interaction and exchange.

Acculturation

There are only a few indications for acculturation in the two research areas. The pottery traditions of LB and LH might both have some formal or relational affiliation with the LBK ceramic repertoire, but whether they were the product of local successors of the Mesolithic remains highly uncertain (see above). Jeunesse (2000) even interprets the similarities in the decorative patterns of La Hoguette and later Rhineland LBK pottery as an indication for the native population's influence on the LBK pottery repertoire.

Morphological attributes of the lithic toolkit, in particular of projectile points,

are another source of information on acculturation. Newell, for instance, proposed clear Mesolithic affinities for the general LBK toolkit in the Netherlands (see Newell in Modderman 1970, 144–83). However, this hypothesis was soon rejected on the basis of rather evident dissimilarities (Louwe Kooijmans 1974; Vermeersch 1990). Better indications exist for projectile points. ‘Danubian’ asymmetric arrowheads with inverse basal retouch (RIP), generally regarded as typically Bandkeramik, are currently believed to have developed from late Mesolithic asymmetrical trapezes from the Loire and LRA (e.g. Jeunesse 2000). Moreover, there seems to be a congruent left- or right-winged spatial division similar for both Mesolithic trapezes and LBK points in respectively the south and the north (for a discussion of this topic, see De Grooth 2005; Jeunesse 2002; Löhner 1994; Verhart in prep. b).

Another line of reasoning regards certain points in Mesolithic sites as having been derived from Bandkeramik examples. A noteworthy site in this respect is Weelde-Paardsdrank in northern Belgium (Huyge and Vermeersch 1982). Nine LBK-like points were found, two of which have evident LBK affinities. The problem is that ‘typological affinity’ is not clearly defined (Van der Graaf 1987, 19). Traits such as ventral retouch are not uncommon among microliths and the existence of atypical LBK-like points is therefore shaded in morphological obscurity. Some evidence for Mesolithic copying of LBK traits might be the fact that true LBK points are also regularly found on Mesolithic sites. These might have had an exemplary function. Examples are the LBK-like and LBK points found at Hardinxveld-Giessendam-Polderweg (Louwe Kooijmans 2003). The genuine LBK point was produced on Rijckholt flint. The location of the site in the central river district (more than 250 km from the Rijckholt source) and its date (c. 5300 cal BC and thus at the start of the LBK occupation of the Graetheide plateau) are emblematic for the early date and considerable distance (either direct or indirect) of forager-farmer interaction.

The coversand area also has several Mesolithic sites with atypical points, notably Lommel (south of Eindhoven) and Budel (west of Weert). Both areas also yielded LBK points (see Van der Graaf 1987).

In the ethnographic literature, projectile points are often shown to be used as bearers or conveyors of group identity in order to distinguish and affiliate. !Kung San projectile points were therefore considered important elements in an elaborate system of exchange (Wiessner 1983). Although a clear metrical definition of true and acculturated point types is necessary, especially in combination with raw material proveniencing, the importance of projectile points as indicators of contact and possibly acculturation seems evident.

Site patterning

Characteristics of LBK and Mesolithic settlement patterns in the region are another source of information. Observed changes during initial and prolonged contact are of special interest. In the light of the above it is, however, clear that the interpretation and chronological resolution of the Mesolithic settlement patterns remains difficult.

Limburg

LBK occupation of the Graetheide plateau can be dated between approximately

5300 and 4900 cal BC. The first settlements can be attributed to Modderman (1970) phase Ib. The early settlements of Geleen, Sittard, Elsloo and Beek were located at close distance to either the Meuse or tributaries such as the Geleenbeek. This left a relatively large terrain untouched. For the end of the LBK occupation (phase IIc/d) some 20 settlements have been documented and a maximum of 2000 LBK people might have populated the Graetheide plateau at the end of this phase (De Grooth 2005, 292). This growth placed increasing demands on the local environment, as the central area of the Graetheide plateau was gradually brought into cultivation. According to Bakels (1978; 1982), the different communities had to work together in order to survive. Furthermore, the shortage of pasture probably necessitated a form of transhumance onto the coversand landscape to the north (Bakels 1978; 1982; Bogucki 1982).

The results of this growth become very visible in the last two phases, as new locations were increasingly exploited, both on and off the loess. It could be suggested that in these two phases, the rigid LBK system witnessed a *peripheral shift* (Amkreutz forthcoming). This remarkable dissociation from the importance of a loess subsoil is emblematically represented by two recently discovered LBK sites on the lower terrace of the Meuse (Amkreutz 2006; Amkreutz forthcoming; Brounen and Vromen 2005). Apparently the old 'rules' with regard to choice of settlement location were increasingly applied in a looser manner (see also Sommer 2001). At the same time, it should be noted that this also involved a shift towards locations with a potentially much stronger Mesolithic signature.

The late Mesolithic occupation of Dutch Limburg is less well known. The coversand area north of the loess-covered Graetheide plateau has yielded relatively abundant information in quantitative respects. Mesolithic sites have been documented on the sandy uplands of Limburg. A more detailed study in the Loobeek microregion near Venray (Verhart 2000, 57–67) indicated a preference for settlement in gradient-rich areas, either near the Meuse or in the source area of various brooks. The sites are mostly situated on elevations such as coversand ridges and dunes (see also Arts 1994; Huyge and Vermeersch 1982).

In contrast, hardly any evidence is known from the loess itself. This has led some authors to believe that these areas were largely devoid of Mesolithic settlement due to their unappealing nature resulting from dense Atlantic forest and presumed low biodiversity (Gronenborn 1999; Modderman 1988; Verhart 2003). The apparent lack of occupation might also be related to the particular taphonomy of the loess region or other research biases (see above). Even in comparison to other parts of the loess belt further west, however, the 'LBK' Graetheide area yielded extremely few Mesolithic traces. This hence seems to be a primary pattern and signals the unattractiveness of the region for Holocene hunter-gatherers. The LBK thus apparently settled in an area that was not intensively exploited by the local last hunter-gatherers (Vanmontfort 2008). Hunter-gatherer activity beyond the Graetheide settlement cluster seems to have been more or less unchanged after LBK arrival.

Hainault

During the 1970s an additional LBK settlement cluster was discovered in the Dendre river source area in Hainault. To date, six settlements have been discovered within an area of less than 20 km² (see Jadin and Hauzeur 2003b). This

area is located approximately 100 km from the nearest other known LBK settlements of the Kleine Gete and Hesbaye settlement clusters. It seems to be a primary pattern, although the presence of as yet undiscovered intermediate settlement clusters cannot entirely be ruled out (Jadin and Hauzeur 2003b). Differences in the physical geography or geology seem, in any case, not able to explain the absence of sites in the intermediate region between Hainault and Hesbaye. The site of Blicquy-Couture du Couvent yielded the oldest assemblage (Constantin *et al.* 1991). It slightly post-dates the first LBK settlements in Limburg and the Hesbaye cluster.

Unfortunately, the small number of settlements makes it difficult to estimate the occupation history of the region. All sites are located on 'typical' LBK spots: on well drained loess plateaux close to open water. It is not unlikely that the Hainault settlement cluster will yield additional sites in the future, but it will most probably remain a rather small settlement cluster. At present there are no indications for a dramatic expansion in the number of settlements or a shift in settlement location, as is the case in the Limburg study region. On the other hand, LBK excursions into the Haine basin in search of raw material are for instance indicated by the use of so-called Ghlin flint in the Hainault LBK sites and the fairly large number of isolated LBK adzes in that region (Jadin and Hauzeur 2003a; Van Assche 2006).

As for the Limburg loess region, the late Mesolithic occupation is less well known. Data is generally restricted to surface collections of concentrations or isolated artefacts. Most of these are located to the south and northwest of the LBK cluster, in regions with a more diverse soilscape, including soils developed on sands (Van Assche 2005; 2006). Mesolithic sites or artefacts from the nuclear zone of LBK occupation are extremely scarce. As for the Limburg area, we could thus conclude that the LBK settled in a region that was not intensely exploited by local hunter-gatherers (see Vanmontfort 2008). Moreover, the arrival of LBK communities does not at all seem to have had an attraction effect on local hunter-gatherer populations (Vanmontfort 2008). Indications for a hunter-gatherer exploitation of the loess belt are more obvious for the intermediate region between Hainault and Hesbaye (Figure 4). Based on a quantitative analysis of individual microliths, it even seems that this exploitation intensified during the later Mesolithic, quite in contrast to that of the Hainault region within a 25 km range around the LBK settlement cluster (Vanmontfort 2008).

Diverging trajectories

The Limburg and Hainault study regions display a number of similarities with regard to both LBK occupation and indications for LBK interaction with other contemporaneous groups in the area. Apart from the known settlements, both regions yielded traces that can best be interpreted as LBK excursions in search of raw material or pasture in a system of transhumance. Direct indications of contact and exchange, both in Neolithic and Mesolithic site contexts, are extremely scarce. No attraction of hunter-gatherers to LBK settlements can be demonstrated, although such an attraction does not need to have had an archaeological reflection.

Nevertheless, a number of clear inter-regional differences can be noted. The number of LBK settlements is much larger in the Graetheide cluster than in the

Dendre river source area, which is only partially due to the longer LBK occupation history. In Limburg, this large number of settlements allows us to identify changes in the occupation pattern. Towards the end of the LBK, the number of settlements increases and they are no longer confined to the typical locations. The small number of sites in Hainault does not allow us to identify such a shift or settlement increase. It most probably remained a fairly small settlement cluster throughout its rather short LBK occupation history.

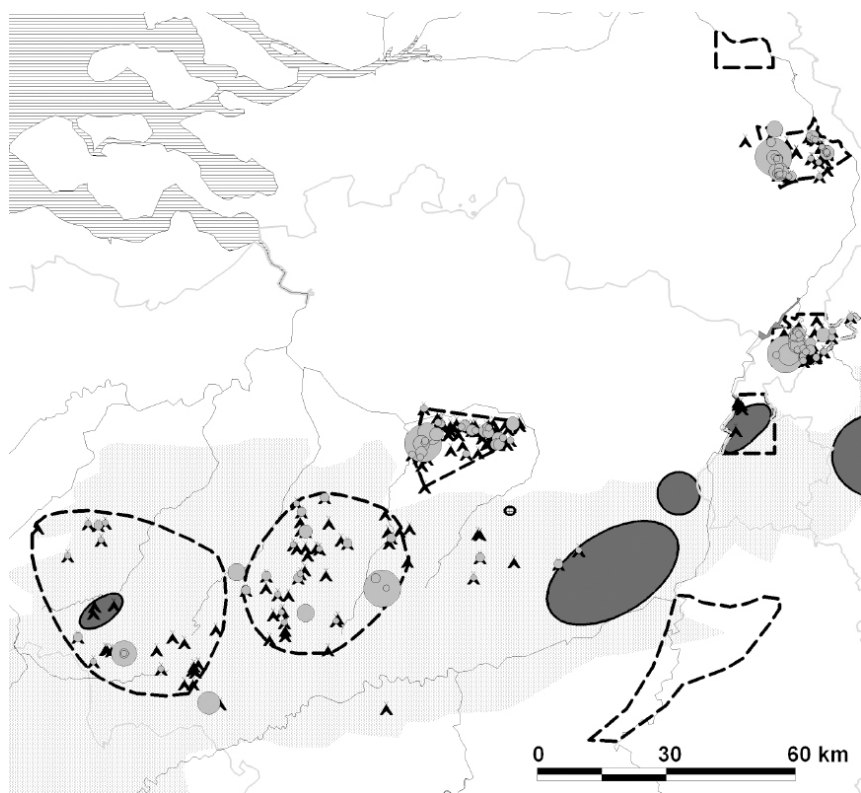


Figure 4. Spatial distribution of microliths in the loess region and five study areas beyond. Spatial data for two of these regions is not available. Key: hatched lines: delimitation of microlith dataset regions; tepees: microlith find spots; circles: trapezes (sizes correspond to numbers 1, 2, 3 or more); hatched areas: LBK settlement clusters.

Another striking difference between both regions is the number of remains that, albeit indirectly, indicate exchange between LBK and other populations. The most indicative items are adzes. In the eastern part of the Low Countries, many adzes are found to the north of the loess, more than 100 km from the nearest known LBK settlement. In the western part, north of the Hainault settlement cluster, hardly any adzes have been found. This difference is even more striking for the spatial distribution of Rössen *Breitkeile* (see Verhart 2000). Even if Rössen settlement sites are lacking west of Maastricht in Limburg, this is a remarkable pattern. It confirms

the difference between the eastern and western part of the LRA (Verhart in prep. a), shown on a more regional scale above.

People of the LBK thus behaved differently in the Limburg and Hainault regions. In Limburg, the LBK expands, people settle in the wider area around the 'original' cluster and indirect indications for contact with other communities are present. The lack of direct indications for contact and exchange is notable. It cannot be regarded as proof for the absence of contacts between the two groups, but is informative on the nature of the interaction. Moreover, farmers may have been predominantly interested in elements useful for their survival, i.e. food, raw materials and organic remains (see Verhart 2000, 32; Zvelebil 1998). Many of these exchange goods may not have been preserved archaeologically. In Hainault, on the other hand, LBK people seem to be much more introspective. The short duration of the LBK occupation in this region allows us to identify it as the pioneer colonization phase of an LBK settlement. While hunter-gatherers might have been kept at bay during this pioneer phase, it is remarkable that no further interaction seems to have taken place. This could be regarded as a conscious decision of avoiding contact.

Models put to the test

Several models providing a framework for the transition to agriculture and the most important distorting factors have been presented in the first sections of this paper. The question is if and how these models stand up to a correlation with the archaeological evidence. It should be stressed here that the single most important premise of this paper is the assumption that native populations were present at the end of the 6th millennium cal BC and that native hunter-gatherer populations at a certain point did come into contact with the Neolithic way of life.

As indicated above, the availability model (Zvelebil and Rowley-Conwy 1984) mainly focuses on the temporal aspect of the transition to agriculture in a particular region. It is a descriptive device and can easily be matched to our own scenario, constructed on the basis of archaeological data. The availability phase probably starts before the establishment of the first LBK settlements in the LRA, hypothetically even with the älteste LBK around 5500 cal BC. The consolidation phase, on the other hand, seems to correspond to the middle Neolithic in the second half of the 5th millennium cal BC (see Vanmontfort 2004; 2007; Verhart 2000). Outside the Swifterbant context, which is not included in the scope of this paper, there are no sites with a faunal spectrum consistent with the substitution phase. Although there are major problems related to the archaeological visibility of the last hunter-gatherers and their early successors (e.g. Vanmontfort 2007), the consolidation phase is most probably restricted to a very short transition phase around the middle of the 5th millennium cal BC. In restricting our scope to the relationship between the LBK and indigenous hunter-gatherers, we are thus confined in this paper to the availability and perhaps part of the substitution phase.

The models of Dennell, Verhart and Gregg deal with the nature of the interaction. The available evidence shows the influx of agriculture with LBK communities. This spread corresponds to a mobile frontier in Dennell's terminology. Natural resource migration can be excluded, since no indications

exist for the presence of domesticates in the LRA prior to LBK arrival. Another unlikely explanation is that of hunter-gatherer acquisition. In the past it has been suggested that the LBK corresponds to a local acculturation of native hunter-gatherer groups (Whittle 1996). The large contrast between the LBK and the local late Mesolithic as currently understood makes this a very unlikely option: transitional complexes are non-existent and material culture, subsistence, mobility and raw material procurement strategies are quite different (see Allard 2005; Louwe Kooijmans 2007; Van Assche 2006). Only two of Dennell's mobile frontier options therefore remain in the running: hunter-gatherer immigration into farmer villages; and colonisation by farmers without hunter-gatherer interference. Although the processes and contact situations involved are highly different, these options are likely to have resulted in a similar archaeological dataset: one of a Neolithic culture within which it is difficult to observe any trace of hunter-gatherer influence.

From the moment of LBK colonisation onwards, no indications exist for a subsequent spread of agriculture or for a Neolithic way of life in the region before the middle of the 5th millennium cal BC, which is beyond the scope of this paper. This implies that after the first influx of the LBK into the region, the archaeological data should be compared with the static frontier options. The two possible options are open and closed static frontiers. The altogether scarce indications of exchange and the absence of indications for conflict rather suggest the first option.

Both contact phases of Verhart's model potentially occurred within the spatio-temporal framework of this paper. In the first phase, contact would have resulted in hunter-gatherers exchanging food and raw materials for what could be labelled as prestige items. The native economic subsystem and consequently also the related settlement patterns would be largely unaffected. The only indications for exchange are the LBK adzes in the eastern part of the study region, found far beyond LBK settlement territory. Given the presumed status of adzes in LBK society, however, their exchange with native populations in this first contact phase is rather unlikely in Verhart's model. They are more likely to be the result of an exchange during the second stage of contact (see below). Raw material exchange cannot be identified with certainty, since the presumed hunter-gatherer raw materials used by LBK communities can be found within reasonable distance from LBK settlement clusters. In the western part of the LRA there is a complete lack of indications for exchange. Within the first contact phase of Verhart's model, it can be explained by the absence of hunter-gatherer communities in this region north of the loess belt; by the absence of a first contact exchange; or by the exchange of items that are not preserved archaeologically. Given the similar absence of first contact exchange items in the eastern LRA, the latter option is reasonable.

In the second contact phase, exchange of objects continues in two out of three options listed by Verhart: that of total dependence and of a symbiotic relationship. Again, taphonomic factors will have their influence on the archaeological visibility of that exchange and again, the LBK adzes in the eastern part of the LRA are the only archaeologically observed indications. These adzes are likely to be the result of exchange during this second contact phase (see above). Another element of these two options is the expected hybridisation in material culture. Elements that can be invoked at this point are the evolved asymmetric arrowheads with RIP of the late or final Mesolithic. Even if the chronological framework does not allow us

to identify the direction of influence, these types are unquestionably related to the so-called Danubian arrowheads typical for the LBK in the region. Both second phase options will additionally have had an important impact on the hunter-gatherer settlement system due to demographic and economic changes. From an archaeological perspective, however, such changes are neither observed for the eastern nor for the western part of the LRA. The overall scarcity of data on late vs. final Mesolithic settlement patterns and systems, however, hampers an evaluation of this aspect.

A third option of the Verhart model results in a complete independence of both groups. This assumes a minimal occurrence of contact finds and a shift away from farmer settlements by hunter-gatherers. However, the presence of a second contact phase exchange of adzes in the eastern part of the region and the close relationship between evolved Mesolithic and LBK arrowheads do not fit this option. An apparent absence of hunter-gatherer attraction to LBK settlements is observed, but it remains highly uncertain whether this equals a shift away from the LBK clusters. A different situation exists in the western part of the LRA, where no second phase exchange is observed. This can be explained by the absence of indigenous groups in this area (see above), but also by considering Verhart's third second phase option of independence.

Gregg's model also provides different options for the relationship between foragers and farmers. In the case of competition, territoriality and aggression will lead to spatially separate settlement patterns or drastic changes after contact. This might explain the general scarcity of contact finds; their paucity would reflect hostilities and raids. The presence of earthworks on the edge of LBK-occupied territory has in the past also been interpreted in this light (e.g. Keeley and Cahen 1989). This is substantiated by the fact that one of the houses at Darion and five of the eight houses of Oleye had burnt down (Keeley and Cahen 1989). Other indications for conflict are, however, lacking and even burnt down houses can of course be explained differently.

In the case of mutualism many different situations might exist. It is nevertheless likely that most changes in settlement patterning would exist in an asymmetrical situation, where one of both parties is dependent on the other for survival. These changes are especially expected in the hunter-gatherer settlement pattern, since they might have depended more and more on agriculture for survival. Such attraction to LBK settlements is, however, entirely absent in the available data in both the eastern and western part of the LRA (Vanmontfort 2007; 2008). Neither of the two options suggested by Gregg thus seems apt to explain the archaeological data.

When working through the archaeological data using the models described above, it appears difficult to distinguish between different phases (*sensu* Verhart 2000; Zvelebil and Rowley-Conwy 1984), different frontiers (Dennell 1985), or different forms of contact (Gregg 1988). The main issues responsible for this are taphonomy and time. The former restricts evidence for interaction to a predominantly lithic affair for which confirmation of actual association is extremely difficult, while temporal resolution is often much too coarse. It is for example virtually impossible to further characterize evidence of interaction or contact beyond LBK settlements within the 400 years of Bandkeramik presence. Furthermore it remains difficult to distinguish whether the mobility of persons,

objects or ideas was responsible for the character of the archaeological record at a certain site. The archaeological evidence for phases, frontiers and the variability in contact is therefore reduced to a palimpsest of processes and interaction. This is aptly illustrated in Figure 5, showing the multitude of actors and developments that might have influenced forager-farmer interaction and that shaped the transition to agriculture in the southern part of the LRA. It will often be difficult to single out or identify one of the options.

From this, it can be concluded that the identification of the character of contact and exchange within one region is fraught with difficulties and problems of multi-interpretability. Moreover, we should assume that the archaeological data actually is the result of a more complex reality, speckled with noise, than is suggested by the polarized options presented in the transition models.

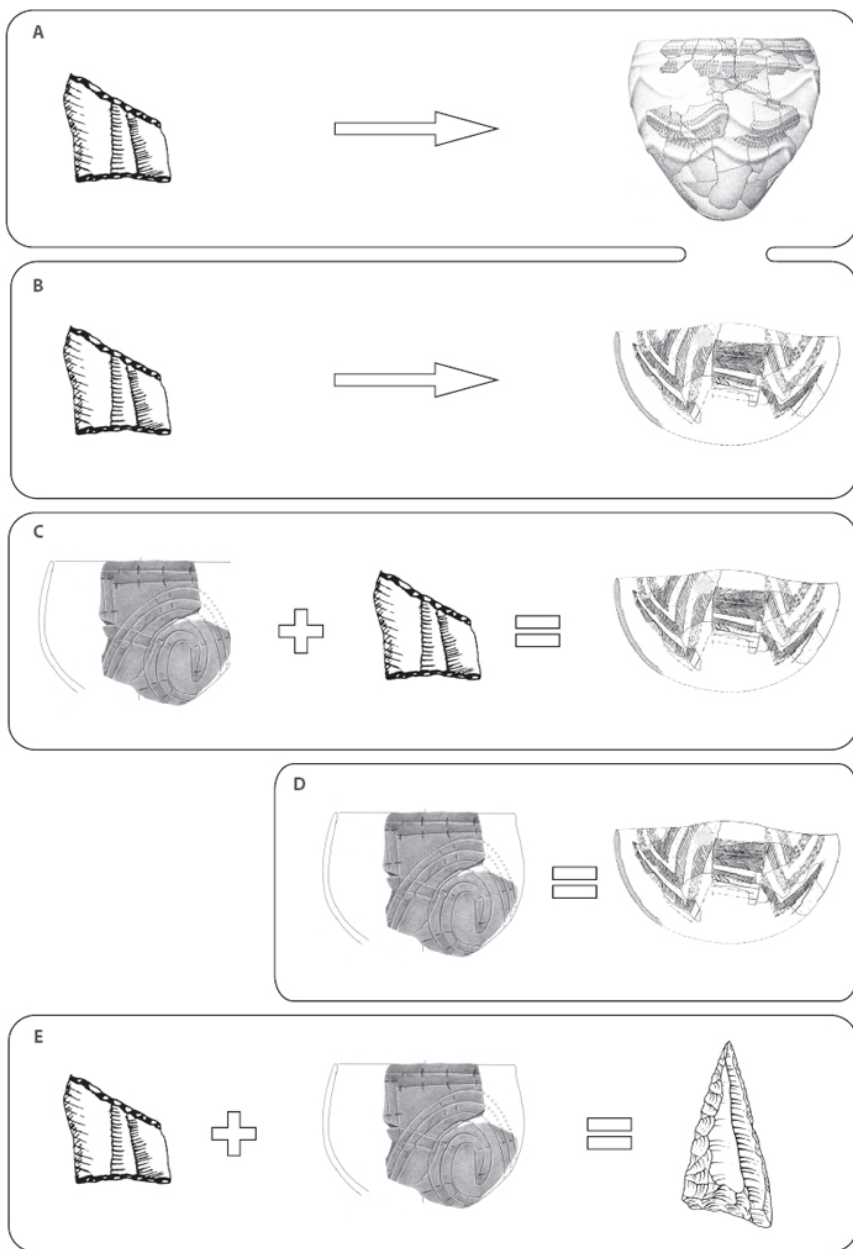


Figure 5. Schematic depiction of the multitude of actors and processes that might be involved in 'a palimpsest of forager-farmer interaction.' A: indigenous development of La Huguette. B: indigenous development of Limburg. Note the connection between scenario A and B, indicating the possibility of a chronological and evolutionary development from La Huguette to Limburg. C: Limburg as a result of LBK interaction with local hunter-

gatherers. D: Limburg as a perhaps functionally specific ware within the LBK. E: indications for acculturation between LBK farmers and local hunter-gatherers as e.g. shown by LBK-like points, or *pointes évoluées* (Limburg ware adapted from Modderman 1974; La Hoguette vessel adapted from Lüning et al. 1989; LBK sherd: adapted from Van de Velde forthcoming).

This is why this paper has focused on the differences and similarities between two regions. The advantage of a comparative study of two adjacent regions lies in contrasting one archaeological situation with another in a manner not based on ethnography or other interpretative frameworks. While this does not exclude the necessity to incorporate and assess the presence of divergent or distorting factors (such as differences in taphonomy etc.), observed differences and similarities could truly reflect past variability. This is why it was concluded above that the processes governing interaction in the Limburg region compared to the Hainault region were divergent and might represent different processes of interaction. Constructing a more elaborate dataset of similar situations and assessing their correspondence will provide a better, bottom-up approach for understanding the variability present in interaction during the process of Neolithisation. Analogously, it should be concluded that many of the other models are useful in constructing a grand narrative, but fail to offer an appropriate perspective for the actual study of interaction as it might have taken place.

Conclusion

Despite the scarcity of information, the reactions to the advent of the LBK and the subsequent development of interaction between foragers and farmers are considerably different in the Limburg and Hainault areas. The subtle evidence for this dissimilarity is not accounted for at the scale of most models of Neolithisation. It is therefore important that we regularly move beyond this top down approach and start again at the base, dealing with the possibilities and impossibilities provided by the archaeological evidence. The increasing awareness of the mosaic character of the process of Neolithisation and the current academic interest in individual and local narratives of change require the information provided by intensive regional research. It is the ability to contextualize and compare the similarities and dissimilarities between the habitus of groups and the conservative or progressive character of their social structure that will increase insight into the workings of the Neolithisation process.

Acknowledgements

The research for this paper is financed by the Netherlands Organisation for Scientific Research (NWO) within the *Malta Harvest* programme ‘*From Hardinxveld to Noordhoorn. From Forager to Farmer*’.

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Frontier settlements of the LBK in central Belgium

Marc Lodewijckx

With a contribution from Corrie Bakels

Introduction

From the north of France to the south of the Netherlands, a wide loess belt runs through central Belgium (Figure 1). This loess region, at present more fertile than it used to be (Langohr 1990), attracted early farmers of the Linearbandkeramik (LBK) culture. These are thought to have migrated into Belgium from the Rhineland (Aldenhovener Platte), passing through the south of the Netherlands. About 150 LBK settlements have hitherto been located in the southeast of the Hesbaye loess region, between the valleys of the rivers Meuse, Geer and Méhaigne. The Méhaigne, a small river that runs into the Meuse, seems to have formed the western border of this migration movement. Many LBK sites were 'excavated' in the late 19th and early 20th century when it was common practice to empty out rubbish pits to collect plenty of archaeological material but no attention was given to the barely discernible post holes that were situated near these pits. The excavations of Buttler and Haberey (1936) at Cologne-Lindenthal in the 1930s and of Modderman and Waterbolk (1958/59) in the south of the Netherlands in the 1950s and 1960s were the first to demonstrate that these settlements comprised complex dwelling structures including post-holes, scoops and enclosures. Roosens (1962) followed this up with his excavations at the Belgian site of Rosmeer.

This contribution reviews the evidence from a cluster of sites in Belgium's Hesbaye loess region. Analyses of pollen, seeds, house architecture and various kinds of artefacts reveals the presence of certain characteristics which are not found in other LBK areas and can be interpreted as influences from local Mesolithic populations. This contributes to debates about the nature of Neolithisation in this area, especially on whether or not contacts between indigenous peoples and incomers were of a violent nature.

A cluster of settlements along the Kleine Gete river

A detailed survey carried out by the author in the north part of the Hesbaye loess region led to the discovery of three new sites of the LBK culture along the Kleine Gete river. The first one was identified in 1977 and is situated to the north of the village of Wange (Wange-Neerhespenveld, Figure 2.1) on the right bank of the

Kleine Gete. The second site is located on the left bank of the Kleine Gete and lies beneath the present village of Overhespen (Overhespen-Sint-Annaveld, Figure 2.2). The third site was discovered in 1989 and is situated at the northern edge of the village of Wange (Wange-Damekot, Figure 2.3), 700 m upstream from the first site at Wange.

With a diameter of c. 120 m, these three settlements along the Kleine Gete are rather small (c. 1.5 ha) and we may assume that they contained only a few individual dwellings. All three are located on a soft hill, flanked by natural gullies, as close as possible to the edge of the alluvial plain. These three sites seem to have formed a regional cluster. Because of their small size and the damage inflicted by erosion, no other sites could be located but we assume some must have existed. The nearest settlement of the southern Hesbaye group is Waremmme in the valley of the Geer, about 17 km to the south-east of Wange.

A few kilometres to the north, there is a rapid transition between the Hesbaye loess zone to the south and the Hageland area to the north. The Hageland has a varied relief with areas of sandy loam, clay and sand. The Steenberg at Wommersom (Figure 2.4) is a long protrusion into this transitional area between the Hesbaye and the Hageland. It forms the only known outcrop of Wommersom quartzite, a source of stone that was very popular amongst Mesolithic hunter-gatherer groups.

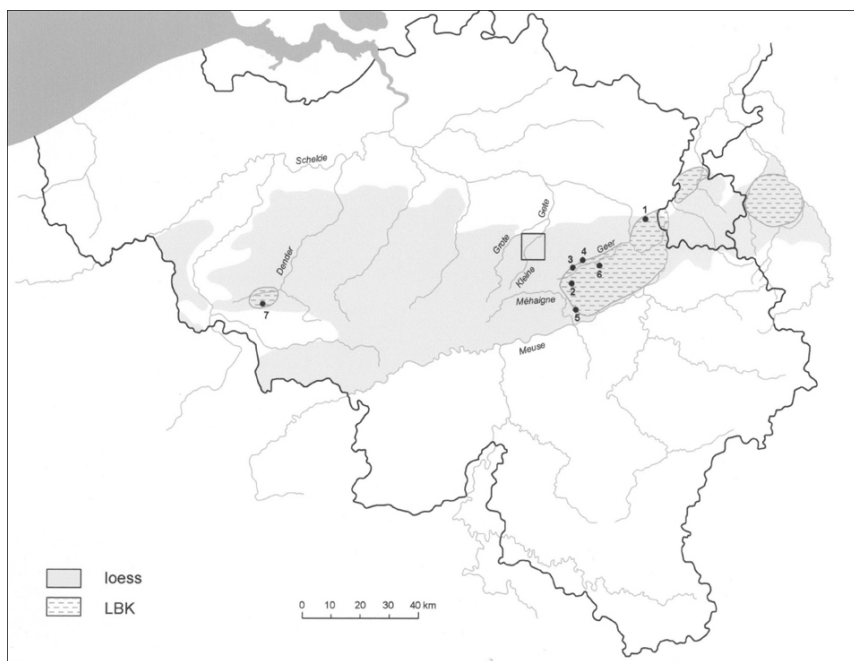


Figure 1. Map of Belgium showing the loess belt (grey), the areas with LBK settlements (stippled) and the sites mentioned in the text: 1. Rosmeer, 2. Darion, 3. Waremmme, 4. Oleye, 5. Vaux-et-Borset, 6. Remicourt, 7. Blicquy. The LBK sites at Wange and Overhespen are shown in the inset (Figure 2).

Pollen analysis (by Corrie Bakels)

An old oxbow of the Kleine Gete offered the opportunity to reconstruct the vegetation cover during the LBK occupation (Bakels 1992). The narrow channel lies 50 m from Wange-Neerhespenveld and 400 m from Overhespen-Sint-Annaveeld and is filled with mainly telmatic peat (Figure 2, black dot). C-14 dating showed that part of the peat formation was contemporaneous with the settlements.

The results of the pollen analysis are pictured in Figure 3. Before 6450 ± 100 BP [(GrN-10720) 5613–5222 cal BC] the main components of the tree cover were lime, elm and hazel. Oak and ash were less important. Other trees, even alder, were nearly absent, as were herbs from dry habitats. The environment in which the LBK people settled was a deciduous forest. Elm forest is thought to have covered the valley floor and the lower slopes. The higher parts of the landscape were covered by lime forest, which is in agreement with the general ideas on the nature of the forest growing on loess plateaux in western Europe (Bakels 1978; Greig 1982; Kalis 1988). Oak and ash were minor constituents in those forests, while hazel grew at the forest edges. Because pollen from herbs growing in open spaces is scarce, these spaces must have been rather restricted in surface area. Herb pollen could obviously not escape into the air above the surrounding vegetation to be transported to the channel in which peat formation took place. On the other hand, the amount of hazel pollen is such that the open spaces must have been rather numerous. Whether these openings were natural or man-made is unclear, but Mesolithic people may have played a role.

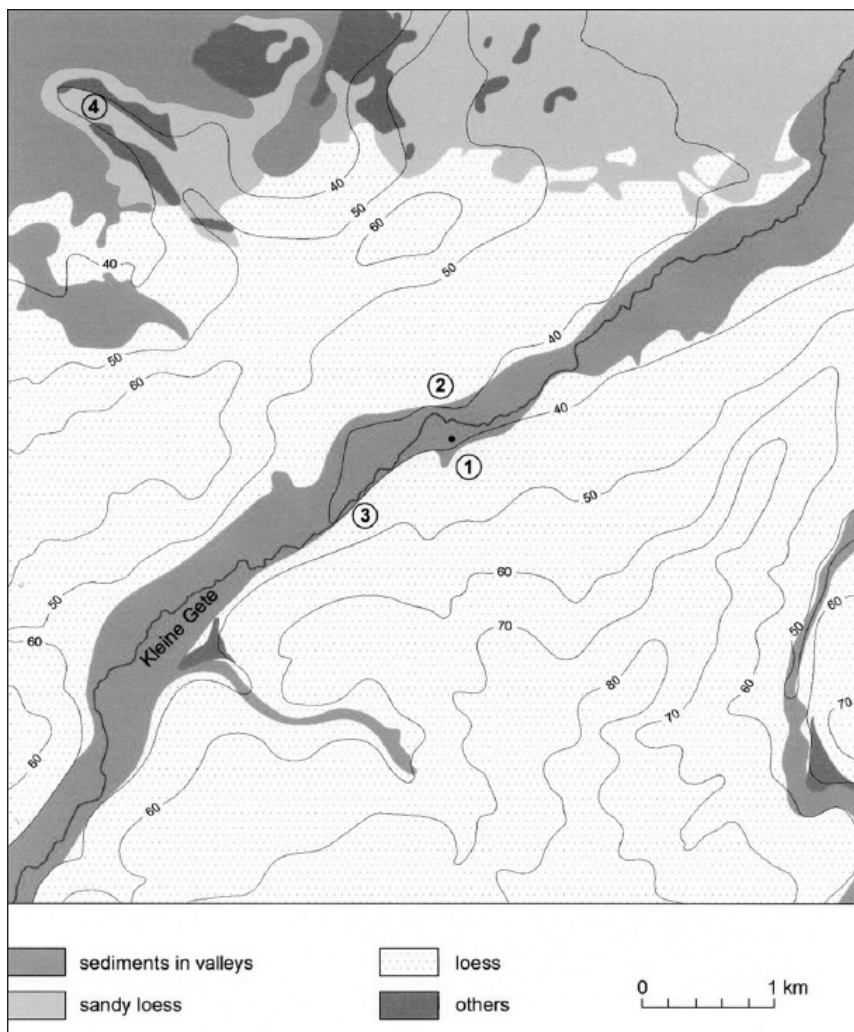


Figure 2. Map of the Kleine Gete area with the sites of Wange-Neerhespenveld (1), Overhespen-Sint-Annaveld (2), Wange-Damekot and the outcrop of Wommersom quartzite (4). The dot indicates the spot where the pollen samples were taken.

From 6450 BP onwards, the composition of the forests changes. Elm declines first, followed by lime. The curves of the pollen percentages of oak and ash rise. The peat shows particles of charcoal. The changes took place between 6450 ± 100 BP [(GrN-10720) 5613–5222 cal BC] and 6150 ± 140 BP [(GrN-10013) 5463–4729 cal BC], which corresponds well with the dates obtained for the LBK settlements, which fall between 6400 and 6130 BP. It is reasonable to attribute them to LBK occupation.

If these were truly contemporary, the elm forest in the valley might have been

cut down to allow better passage between the Wange and Overhespen sites. They might also have been damaged by the browsing of cattle or the collection of animal feed. Moreover, part of the terrain on which the settlements were founded might have been covered by elm forest and the trees might have been cut down to make space for dwellings. The deforestation was not important enough to have created larger stretches of open ground as the curve of herb pollen did not rise. Only a few goosefoot pollen and a single grain of great plantain are witnesses of possible human impact. Both are considered as ‘anthropogenic indicators’ (Behre 1986).

The lime forest may have been partly cut down to make room for fields. No cereal pollen was encountered, but as the LBK cereals did not shed pollen freely and small fields go undetected if surrounded by trees and shrubs (Broström *et al.* 1998), this was to be expected. Ash and especially oak profited from the felling of elm and lime. After 6150 BP the forests recovered to a certain extent.

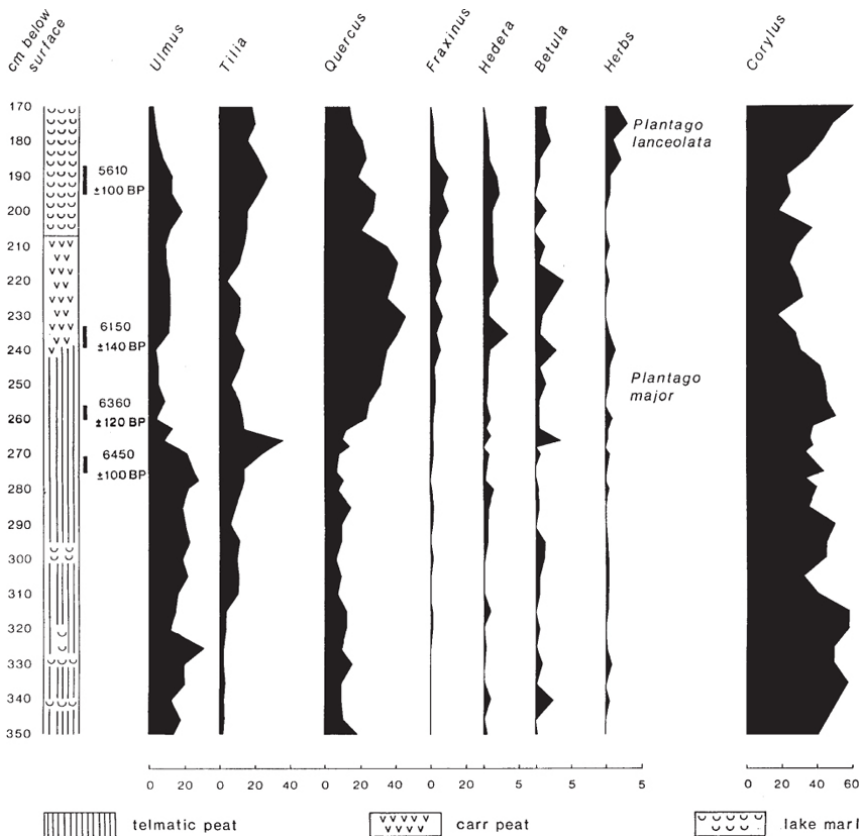


Figure 3. Results of the pollen analysis by Corrie Bakels.

The settlement structures

Since ours was mainly a rescue dig the excavations only exposed a small part of the three LBK settlements of the Kleine Gete cluster. More recent constructions and agricultural activities, which damaged the sites, also made it impossible to determine the true extent of the settlements. In some parts erosion had truncated features, so that only the bottom of some pits had been preserved.

The only complete plan recovered was at Overhespen (Figure 4) where a northwest-southeast oriented house measuring 26 m by 6.5 m was found. While the traditional LBK houses have a rectangular form, this house narrows slightly at its northwest end. Like most LBK longhouses, the Overhespen house preserves more postholes to the northwest but, in contrast to the known dwellings, it has no continuous wall trench. Two other structures were located to the east, but both were barely preserved and only visible under good humidity conditions. At Wange-Neerhespenveld, a single cluster of postholes was discovered but only partly investigated. The structure has the same orientation and size as the known dwellings. At Wange-Damekot, no LBK postholes were identified because of more recent occupation. Apart from a palisade at Overhespen, no defensive structures could be identified.

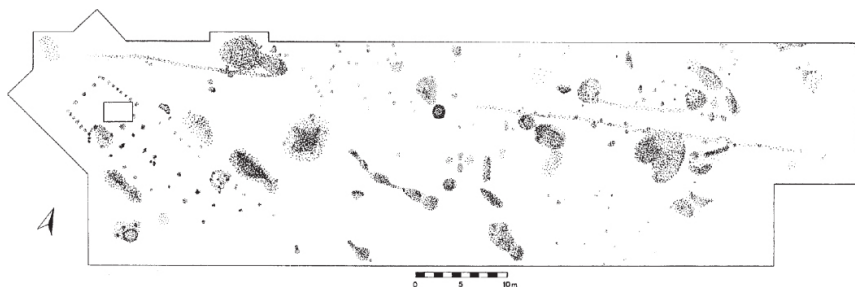


Figure 4. North part of the LBK settlement at Overhespen-Sint-Annaveld. The house discussed here is situated to the left.

The excavations did reveal a surprisingly high number of LBK pits, especially at Wange-Neerhespenveld. Most of these share a particular form which seems to suggest that they were originally made for a single purpose. Long pits along the walls of the houses are presumably loam pits. Cylindrical pits, often clustering in groups, were probably silos, whereas others may be interpreted as ovens or kilns (Figure 5). Although several other types of pits and complex structures can be observed, their functions remain enigmatic. Various types of pits were dug close to the houses, but others are situated at the edge of the settlement, perhaps in some kind of semi-industrial zone. These may be suggestive of the various activities of the inhabitants. Most pits were later used to dump household refuse. In this way, especially pottery sherds and flint tools were preserved, which help to complete the fragmentary picture provided by the soil traces. Research on animal bones carried out by Dr. Wim Van Neer of the Koninklijk Museum voor Midden-Afrika at Tervuren showed that cattle, sheep/goats and pigs were kept.

We were not able to establish any internal chronology for the sites. The settlements seem to have been conceived as a whole from the beginning. No overlap of structures or pits was recorded during the excavations. The observation

that the rubbish in several pits was restricted to the bottom leads to the assumption that the settlements were deserted after a rather short period of time. C-14 analysis on charcoal from the bottom layers of the pits gave six dates for Wange-Damekot. The only determination carried out on nut shells, 5308–4848 cal BC (KIK–352/UtC–3678) for Wange-Neerhespenveld, probably is the most accurate (see also Table 1).

Pottery

Next, we will discuss the main features of the pottery recovered from the LBK sites along the Kleine Gete (Figure 6). The composition of the fabric and the addition of temper are clearly related to the size of the vessel. For larger objects, mainly grog was used as temper. Grog temper was also found in quite a few of the smaller vessels, although fine grogs can be hard to identify. In some of the small vessels sand was evidently mixed in as temper. We suspect that this sand came from sandstones, as a number of abraded sandstones with similar features were found on the site. Organic temper was also used to a limited degree; this can be deduced from the many voids in the fabric of some of the vessels. Most voids have a round shape, but elongated ones also occur. It is not clear what material was used for this temper.

Pottery can be formed in various ways. A common technique is to build the wall up using coils of clay, which are placed on top of each other to form a spiral, and then to smooth the coils together. A comparable technique is to form the vessel using slabs of clay. In both cases, the fracture lines will more often than not occur where the coils or slabs meet. However, like other researchers, we found no indications of either technique, especially not of the coiling technique, in the pottery of the LBK settlements at Wange and Overhespen. The sherds are very varied in form and size and have straight fracture surfaces. The sherds are not broken in the usual way in which ceramics built from clay coils break. Judging by the sherds, which can be very thin, potters always tried to achieve minimal thickness. The base is generally convex and so follows the profile of the vessel wall. Generally, the rims of the pots, especially the smaller ones, are no thinner or hardly any thinner than the wall of the belly of the pot. The surface of the great majority of the pots has been smoothed and sometimes even polished, but we do not know by what method. The colour of the pots varies widely, from black to grey to brown, with finely tempered pots being more often dark in colour, and the coarsely tempered pots more often of paler hue. The hardness of the fabric is determined by the composition of the temper: a fine-grained temper makes a hard pot.

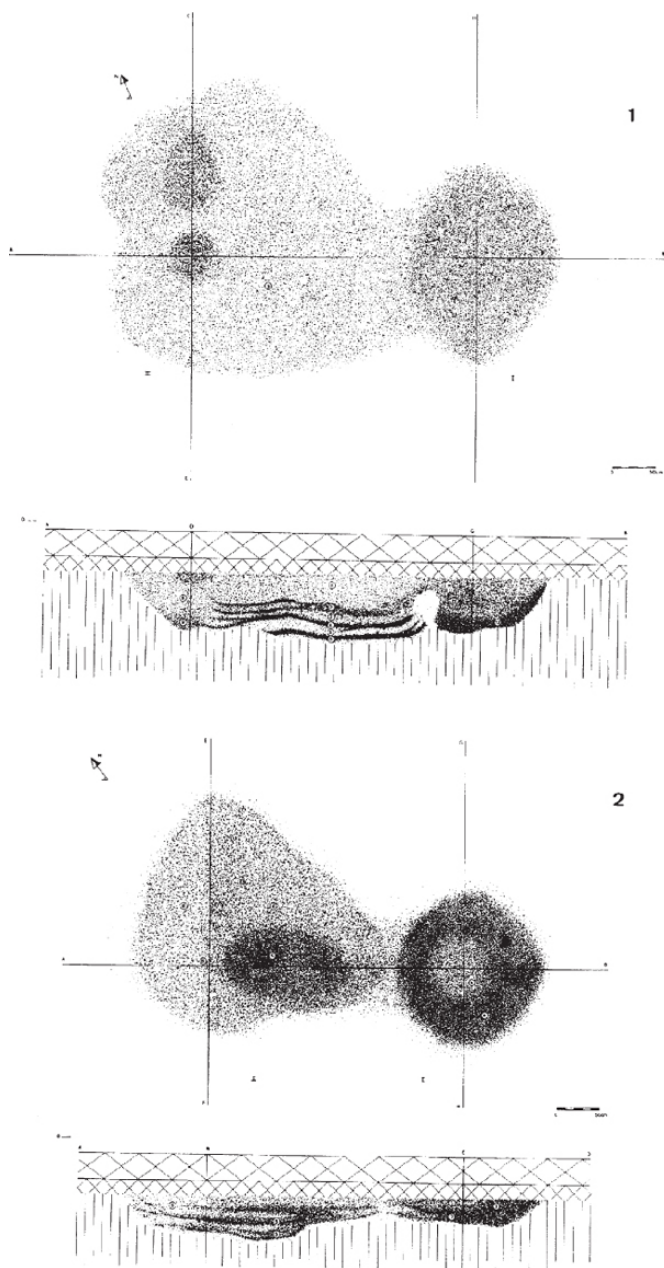


Figure 5. Plan and section of two similar pits in the LBK settlement at Overhespen-Sint-Annaveeld. Their form, fill and orientation suggest that they were used as ovens or kilns.

Table 1. The radiocarbon dates for Overhespen-Sint-Annaveeld, Wange-Neerhespenveld and Wange-Damekoft. Dates cal BC are given at 95.4% probability. Dates calibrated

using the OxCal 3 programme.

<i>Site</i>	<i>Sample code</i>	<i>Radiocarbon date (BP)</i>	<i>Calibrated date (cal BC)</i>
Overhespen-Sint-Annaveeld	GrN-12.620	6400 ± 100	5650-5050
	GrN-12.619	6190 ± 70	5310-4960
	KIK-392/UtC-3734	6130 ± 45	5220-4950
Wange-Neerhespenveld	Lv-1116	6310 ± 75	5470-5060
	KIK-352/UtC-3678	6150 ± 90	5310-4840
Wange-Damekot	KIK-366/UtC-3718	6250 ± 50	5330-5050

The typological variation of the LBK pottery found at Wange and Overhespen is very great. In summary, one can say that the decorated pots most frequently have the pear-shaped profile which is characteristic of LBK pottery (78 %) and that the remainder consists largely of barrel-shaped pots with similar features, but without the characteristic shoulders of the pear-shaped pots. A number of bottles with decorative patterns were also found, but most of these belong to the category of undecorated ceramics. The variation within the group of coarse ware is actually greater. Besides the pear-shaped and barrel-shaped pots, this group also includes open, semi-spherical and more closed bowls. Bottles are less well represented. Exceptional forms are the cylindrical beakers, plates and scoops. Regarding the applied attachments, too, there are many variations. The smaller pots usually do not have plastic attributes, whilst the bigger ones often have four knobs, which are evenly distributed over the widest diameter (the belly) or under the rim. Still larger pots often have perforated ears attached to the belly and plastic attachments on the rim, whilst the large containers have upwardly orientated knobs on the belly so that they can be carried on the head. The bowls usually only have plastic attachments, such as round or elongate knobs, on their rims.

The decoration patterns were usually made by drawing lines or by stabbing points or making fingernail impressions when the clay was leather-hard. Few pots demonstrate a decoration achieved by the surface being modelled by finger pinching or a combination of different decorative techniques. The final result also depended on what instrument was used, usually a lath with one or more teeth (a comb) that was used in a dragging or stabbing movement. A different tool was often used for the rim decoration than for the principal decoration. For the decoration outside the bands a different technique was usually applied (e.g. fingernail impressions), from which one can conclude that great care was taken in pottery production.

Regarding the decorative patterns, too, only a brief summary is possible here. The simple configuration, where the principal decoration zigzags across the surface, dominates. Angular and undulating designs were favoured equally. On the bigger pots, these patterns are often repeated above and below the widest diameter of the vessel, usually marked by four knobs. Other motifs, such as spirals, are rare. Decorative patterns covering the whole wall, such as fingernail impressions, are

also exceptional. Predominantly, bands of two parallel lines were applied which were filled in either with lines or dots. A comb spatula was used in only one third of all cases. Still, within this framework a wide range of designs is possible, and every single pot in fact has its own particular decoration scheme (Figure 6) which consists of several elements: the general design, the main motif, with possible secondary decoration within the bands and different ways of interrupting the bands, types of decoration between bands and finally the rim decoration. These elements, which can occur in combination with plastic attachments, were chosen in such a way that the entire wall surface was more or less evenly covered and the whole gave a harmonious outcome. Often, the potters went to a lot of trouble in their work (by using different types of spatulas, for example) and evidently did not begrudge the effort.

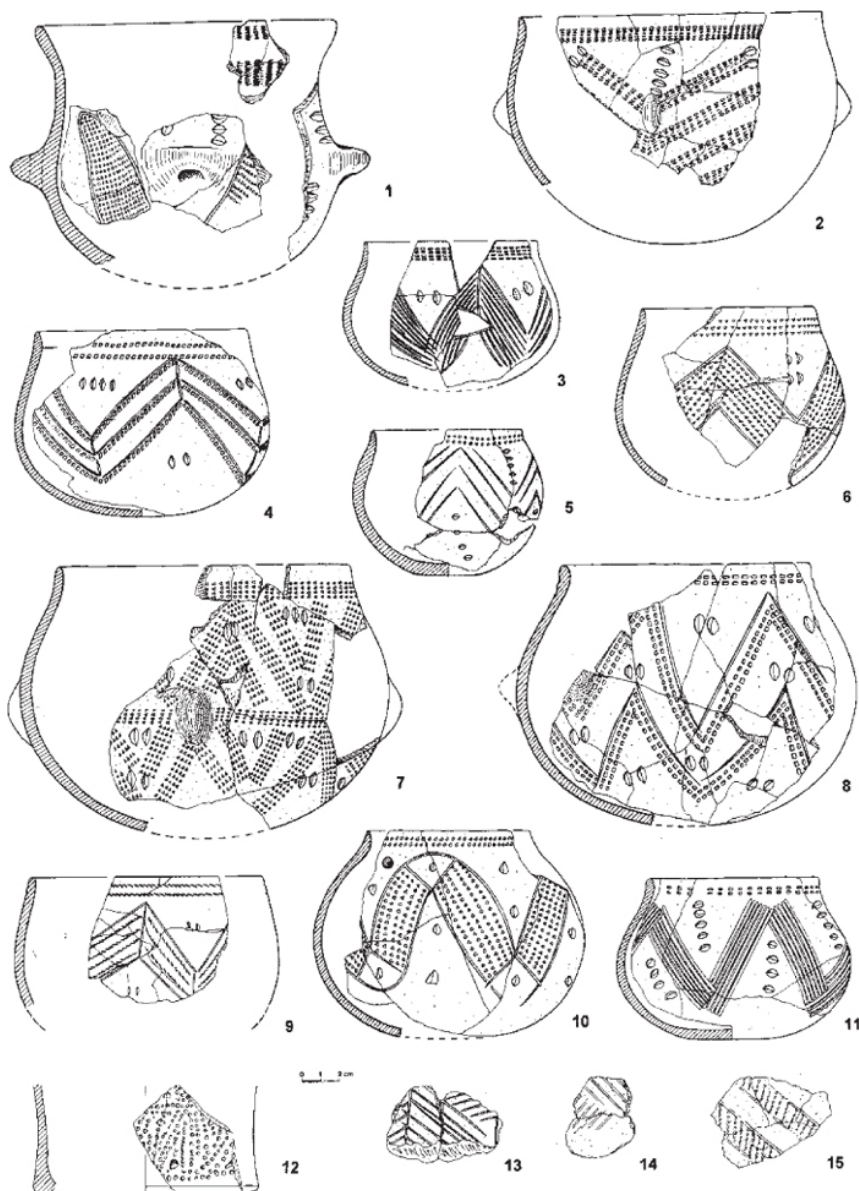


Figure 6. Some examples of the fine ware from the LBK settlements along the Kleine Gete. Numbers 12–15 are attributed to the Limburgkeramik.

Different styles of decoration patterns occur on the sites of Wange and Overhespen. The simplest decorations show widely spaced bundles of broad parallel lines which, in practice, occur only in an undulating version and in

combination with a simpler rim and secondary decoration. On other pots the lines are placed a little closer together or the lines or dots within the bands are still relatively far apart. There are no secondary types of decoration within the bands and the rim decoration usually consists of parallel lines and dots, whilst fingernail impressions are used between the bands. More elaborate patterns are used on other pots where the decoration is denser; the decorative elements are applied with a finer spatula and secondary band decoration and more decorative elements outside the bands are applied, often with a comb spatula. Finally there are pots the whole surface of which is covered with one single decoration type, such as fingernail impressions or pinches.

We were able to ascertain that these different styles were distributed almost homogeneously across the sites and the various pits and that no chronological significance can be attached to them, as was demonstrated by the seriations that were carried out. Apparently, the application of an angular or undulating design does not have any chronological significance either, as both occur in comparable quantities in the various pits.

A few sherds are totally different in tempering material, shape and decoration techniques (Figure 6, 12–15). Pots are usually semi-spherical and show small fragments of bone as tempering material. One bottom fragment (Figure 6, 12) clearly belongs to a cylindrical beaker. Based on these characteristics we believe that these sherds can be attributed to the Limburg pottery, which is accredited to another population (Modderman 1981; van Berg 1990). Although doubts have arisen in the meantime about the extent to which all the sherds that have been described as *Limburgkeramik* in the literature belong to the same cultural group, we believe that, for the time being, we are justified in maintaining the attribution of our sherds.

Some of the most characteristic sherds were found in the rubbish pits of the LBK settlement at Overhespen. They have very thin walls and are made of a hard but very brittle fabric with a fine temper composed of grog and organic materials with a small admixture of fine, possibly burnt bone fragments. The surface has been smoothed in all cases, but usually exhibits an abundance of small round voids from the organic temper. The fractured surfaces are sometimes remarkably oblique (Figure 6, 13). The colour varies from beige to almost black, although most of the decorated sherds are red-brown. The decoration, which consists of lines, has been applied very superficially and usually is only visible in shadow contrast. The dots have been stabbed a little deeper but, because of their small dimensions, they are hard to distinguish from the little holes left by the organic temper. A very characteristic feature is the sharp angle at which the decoration was applied.

This group of sherds thus exhibits almost all the characteristic features of *Limburgkeramik* and provides evidence for the presence of these ceramics on the sites of Wange and Overhespen. In addition, sherds with similar technological features occur; in particular, the fine organic temper, the thinness of the walls and the carefully smoothed surface, which distinguishes them from traditional LBK pottery. A number of pits contain assemblages of these sherds which are something in between typical LBK pottery and *Limburgkeramik*. In most cases these ceramics are very fragmented, but bigger sherds too can raise doubt. Several colleagues have made similar observations in the literature. The question is whether the *Limburgkeramik* and the LBK pottery are always that distinct, and whether both

groups – even if they had different origins and pottery traditions – may not have met, resulting in a mutual exchange of know-how.

Toolkit

Flint tools are abundant at the three sites but neither cores nor flakes nor other flint production waste were found. Flint is not to be found in the region but is quite abundant in the south of the Hesbaye, where it can be found as large nodules on the valley floors. Hence, one can assume that blades or finished tools were imported from sites in the Hesbaye region, where several LBK flint workshops have been identified (Jadin 1990; Vanderhoeft *et al.* 1996; Burnez-Lanotte and Allard 1997). The LBK tool kit is completely made of blades and consists of endscrapers, truncated blades, blades with traces of wear, sickle blades, burins and asymmetrical arrowheads (Figure 7). These are the standard tools of the western LBK. Flaking waste only consists of very small retouch or re-sharpening chips.

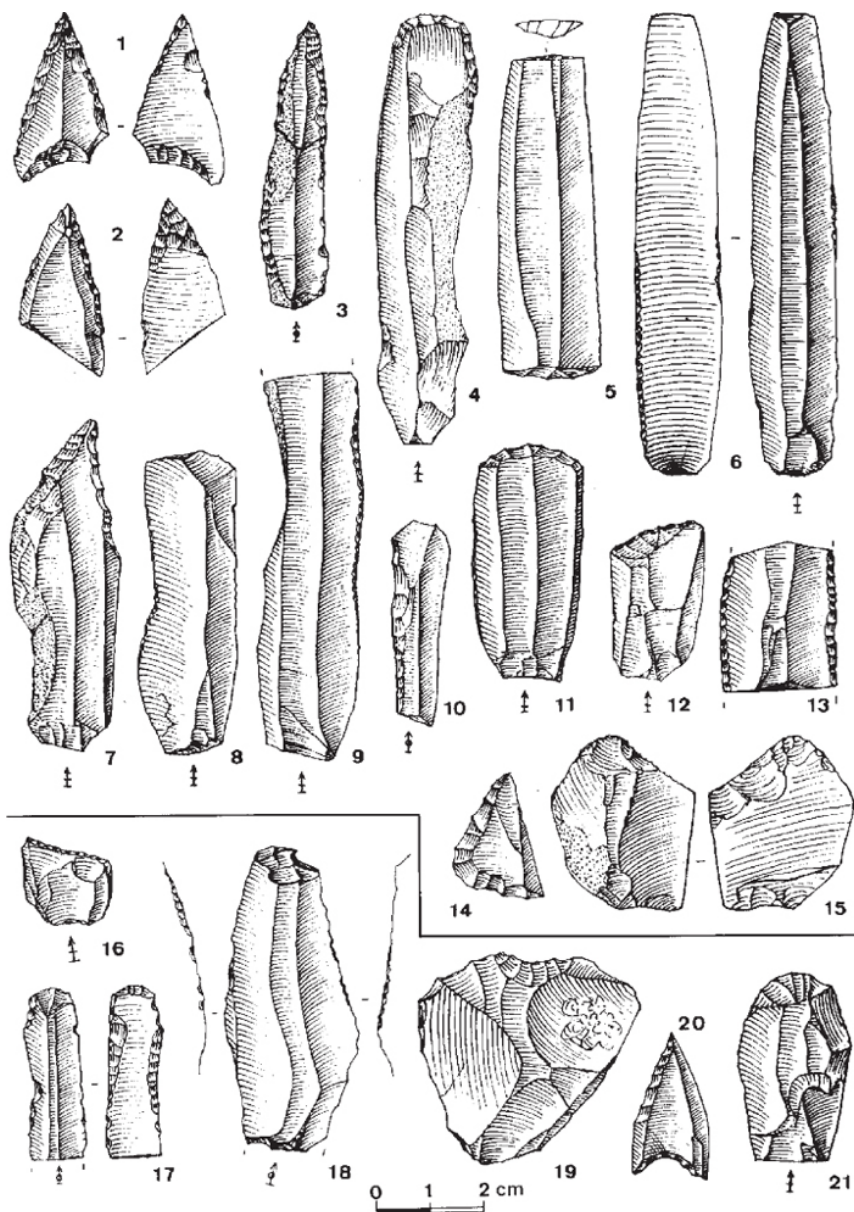


Figure 7. Flint (1–10) and Wommersom quartzite (16–21) tools from the LBK pits.

Besides the flint tools, many artefacts made in a fine-grained quartzite were recovered (Figure 7.16–7.21). They originate from an outcrop at Wommersom (Figure 2.4), a site only 3.5 km away from the nearest settlement. At that spot, this raw material can be found in the form of flat fractions, splintered from the original

bedrock by frost. Hence, these blocks had to be knapped in a specific way, beginning at one of the small edges. Depending on the site, the total amount of artefacts in Wommersom quartzite varies from nine to ten percent of the total amount of artefacts. Since artefacts in Wommersom are fresh and fragments can sometimes be joined, it is likely that the Wommersom quartzite was processed within the LBK settlements. No typical LBK or Mesolithic tools in Wommersom quartzite were found. One arrowhead has a concave base but no ventral retouch (Figure 7.20) and one scraper looks like an LBK endscraper but was made out of a flake (Figure 7.21). A few artefacts in Wommersom quartzite have been found at the adjacent sites in southern Hesbaye (Jadin 1990, 149).

Adzes in lydite from Ottignies-Mousty, which is 36 km to the southwest, were also produced in all three settlements. Several unfinished adzes (Figure 8.5) and hundreds of flakes were found in the LBK pits. Adzes vary from flat and large to high and long ones (Figure 8.1). Most of them were broken and left behind, obviously because there was no shortage of raw material. The techniques used to manufacture LBK adzes in lydite appear quite similar to those used on Wommersom quartzite. When shaped into a suitable form, the adzes were carefully polished. The corresponding whetstones are made out of iron-sandstone that originates from the Hageland. Adzes in lydite from Wange and Overhespen were found on many sites in Belgium, the Netherlands and even Germany (Toussaint and Toussaint 1980/82; Caspar 1984). Several artefacts in lydite appear to be small axes (Figure 8.2). In contrast to adzes, axes have a symmetrical cutting edge and their sides and heel are left unpolished. Several other atypical tools were made out of lydite (Figure 8.3 and 8.4). Millstones of different sizes were made out of a local rough quartzite.

Analysis of carbonised seeds (by Corrie Bakels)

The agricultural activities of the inhabitants of the Wange and Overhespen settlements are to a certain extent reflected in the carbonised plant remains they left behind (see Appendix). These were recovered by wetsieving the fill of the pits. In total, 17 soil samples from Wange-Neerhespenveld, 28 samples from Overhespen-Sint-Annveld and 12 samples from Wange-Damekot have been analysed (Bakels 1992; Bakels pers. comm.). Not every sample revealed remains, but the results of those that did were rather similar. The appendix lists the species with the number of samples in which they have been encountered. Only fragments of unidentifiable cereals were not entered, but they occurred everywhere. *Pisum sativum* 2 in Wange-Damekot means, for instance, that in two of the ten samples with carbonised seeds one or more peas were found.

The table shows that at least four cultivated plants were present: naked barley, emmer wheat, einkorn wheat and pea. Hazelnuts and sloe plums were probably gathered. The ivy and lime fruits might have been brought in with branches lopped for fire-wood or animal feed. The herbs belong to the field weeds of the LBK, even if some of the species are not considered as field weeds in present times (Knörzer 1971; Bakels and Rousselle 1985). Emmer, einkorn and pea are common LBK crop plants.

The surprise is the naked barley. It is found in all three settlements. It is not found in the vast range of settlements excavated in the loess belt between the

Rhine and the Méhaigne. This cereal is also absent from other classical LBK 'core' areas such as Lower Bavaria. As one of the main cereals grown, next to emmer and einkorn, the plant does turn up in LBK settlements situated in landscapes belonging to Sielmann's 'ökologie-Kreis B' (Sielmann 1972). The regions with barley nearest to the Kleine Gete area are the Neckar area in Germany and the Aisne valley in France.

Why was barley cultivated regularly in the Kleine Gete area? The reason might be a climatological or pedological one. Barley is rather hardy. However, a climatological cause is not plausible, because there cannot have been much climatological difference with the adjacent loess belt. The soils, on the contrary, might have been less fertile. The area borders the sandy loam of the Hageland. But there is a third possibility, which is not environmental. It might be that the human population was not 'classic' LBK but influenced by other customs and tastes. I have suggested that the barley might have been introduced by non-LBK people (Bakels 1992). As a matter of fact, naked barley was a quite common cereal in early Neolithic cultures further to the south (Marnival 1988). Whether triggered by environmental or cultural causes, the occurrence of barley as a main crop in LBK societies deserves special attention.

Characteristics of the sites at Wange and Overhespen

After summarising this data, one can first of all conclude that the three LBK settlements along the Kleine Gete at Wange and at Overhespen correspond to the traditional image of the LBK; clustered settlements in a rolling landscape in the loess region, rectangular house plans with rubbish pits in the vicinity, pear-shaped vessels with the typical LBK decoration, traditional tools on flint blades, adzes made from ground stone, the cultivation of emmer, einkorn wheat and pea, the evidence of tool use, such as blades with sickle gloss and millstones, and the keeping of cattle, sheep, goats and pigs. Also the occurrence of *Limburgkeramik* is not unique, even if its origin is not all that obvious. Most exceptional for the settlements along the Kleine Gete are the following additional characteristics: a small group of settlements beyond the traditional area of distribution of the LBK, slightly trapezoidal house plans, clusters of pits of a type which apparently has not been found elsewhere, the proximity to the outcrop of Wommersom quartzite that was processed locally, workshops where adzes were made in lydite, the presence of small axes, and especially the occurrence of barley.

We conclude that the inhabitants of the sites at Wange and Overhespen must have had strong connections with the LBK. They most probably had their roots in LBK societies. The tradition of oblong house constructions, the economy based on agriculture and cattle breeding, the typical tools and ceramics clearly belong to the characteristic western LBK as it is found in the south Hesbaye region, the Netherlands and the Rhineland. It is also typical of the LBK that each settlement had its own specialisation within its group (Cahen *et al.* 1990, 130). Our own investigations led to the conclusion that all types of flint material were imported as blades or finished tools from settlements from the south Hesbaye region, where flint can be found in the valleys and where conclusive evidence for large scale flint knapping exists (Jadin 1990).

Nevertheless, the LBK settlements along the Kleine Gete also took care of their

own knapping, although it was limited to Wommersom quartzite and lydite. These two types of stone most commonly occur as fairly flat blocks, which had to be knapped in a specific way. The technique differs from the more prevailing flint knapping techniques. The exploitation, processing and distribution of these materials are most frequently associated with indigenous groups. The appearance of these stone types within the LBK settlements seems to indicate that the LBK inhabitants either took over this way of exploitation, or that they had a good contact with the local groups who kept up these traditions. The fact that the stoneworkers at Wange and Overhespen did not make typical LBK tools creates room for the interpretation that they were not of LBK origin. The observation that they specialised in making typical LBK adzes of excellent quality, tools which were more widespread in other LBK regions in the east, hints at a strong integration into the LBK economy. Moreover, we see that adzes and arrowheads of LBK type were also discovered in the more northern area of the Hageland, a region where LBK settlements have not been discovered. In addition, the iron-sandstone which was used to polish the adzes appears to come from the Hageland. Therefore it is possible that part of the inhabitants of the LBK settlements at Wange and Overhespen did not have LBK origins.

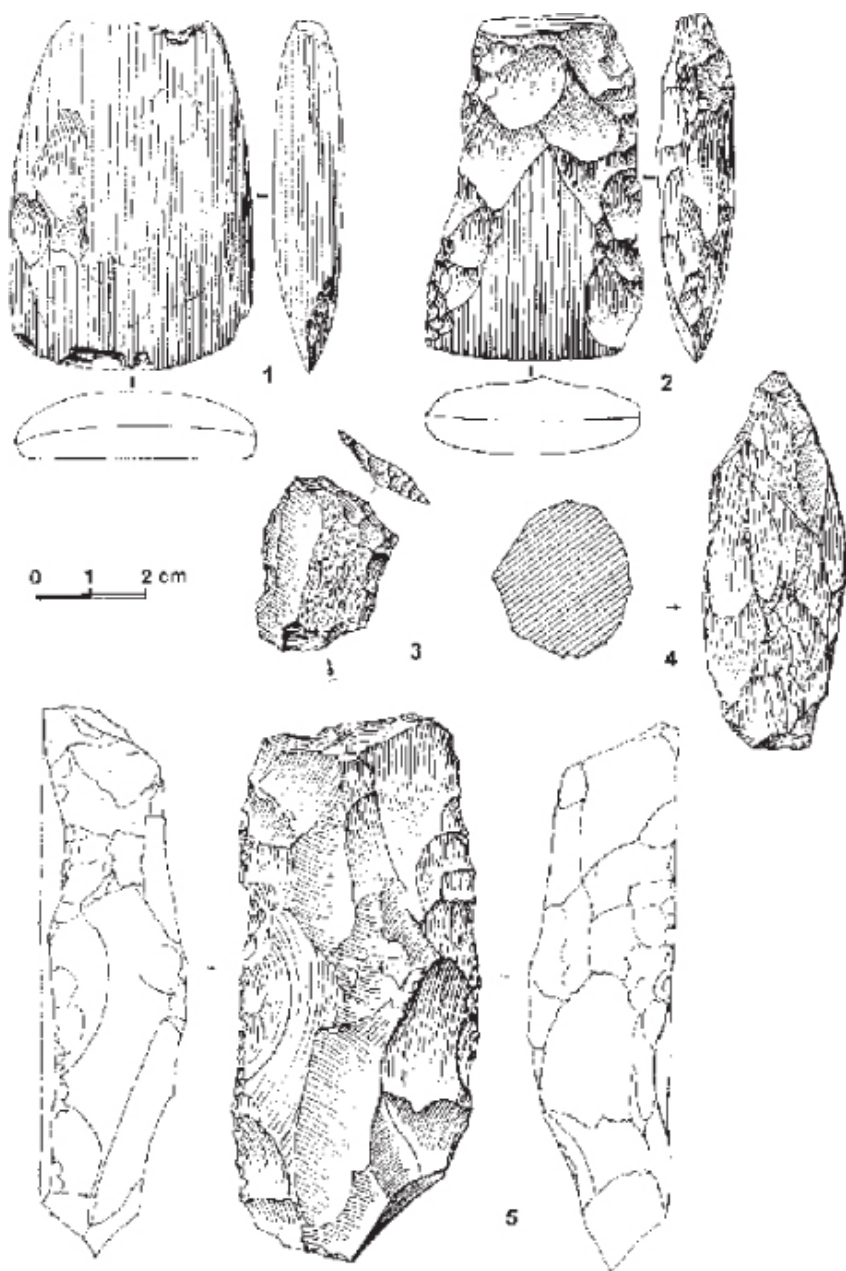


Figure 8. Unfinished adze (5), adze (1), axe (2) and other tools in lydite.

The occurrence of Limburg pottery also points to the presence of a non-LBK population, which may or may not have been permanent. *Limburgkeramik* differs

too much from LBK pottery to be considered a variant (van Berg 1990, 171). The chances for this ceramic to be preserved outside the protective environment of a LBK rubbish pit are very slim but not non-existent (Modderman 1981). In spite of this, *Limburgkeramik* appears to be widespread. It is still unclear who the producers of *Limburgkeramik* were. They nevertheless appear to constitute a significant component in the context of the early Neolithic populations. Even though it is most commonly accepted that they had their roots in the more indigenous groups, they may have had customs comparable to those of LBK societies. However, the lack of distinct traces and archaeological material makes them archaeologically invisible and renders it difficult to estimate their influence and position in the Neolithisation process in central Belgium.

We next return to the discovery of barley within the LBK sites along the Kleine Gete. The presence of barley on the three sites suggests that this is not a coincidence. Moreover, the sampling of the LBK pits was carried out very carefully. The occurrence of barley is an important indication of the influence of non-LBK groups. At this stage, the chronological relation with other barley cultivating sites in the early Neolithic is not completely clear. However, the sites along the Kleine Gete seem to have fulfilled a pioneering function. Whether the barley at Wange and Overhespen was imported via the same population group as the *Limburgkeramik* and the lydite manufacturers is not yet clear.

The early Neolithic period in Belgium: some reflections

When placing these elements in a broader context, we notice that an isolated group of LBK settlements was found in the loess area in western Belgium (Figure 1). At present, five rather small LBK settlements (c. 1.5 ha) are known in the neighbourhood of the sources of the Dender, in the Hainaut province (Constantin *et al.* 1980; Constantin 1985; Cahen *et al.* 1993; Constantin and Demarez 1997; Gillet *et al.* 1997; Bosquet and Livingstone Smith 1997). This cluster of settlements is situated about 100 km west of the nearest LBK settlement in the Hesbaye area. Nevertheless, their archaeological features seem very similar to those of the Hesbaye settlements. Due to massive erosion processes in the loess area, few house plans were recovered. These appear to have been very similar in plan and construction and were accompanied by the typical elongated rubbish pits. A morphological, technical and decorative comparison of the ceramic production underlines the great similarities with the Hesbaye area. The LBK pottery is frequently associated with *Limburgkeramik* and the range of tools from these Hainaut settlements is identical to the Hesbaye toolkit. Alongside the imported flint from the Hesbaye region, local flint was also used. These settlements appear to have been occupied for a rather short time period. At present, it is not clear why this LBK population, which was apparently of Hesbaye origin, moved so far westward.

Detailed excavations have demonstrated that various settlements along the northwest border of the LBK cluster in the southern Hesbaye (Figure 1) appeared to have been fortified with walls and ditches: Darion (Cahen *et al.* 1985), Waremmes (Trocki *et al.* 1988; Keeley and Cahen 1989), Oleye (Cahen *et al.* 1990; Figure 9), Vaux-et-Borset (Caspar *et al.* 1992) and Remicourt (Bosquet *et al.* 1997; Bosquet and Prued'Homme 1998). Within this context, it is somewhat peculiar that

neither the settlements along the Kleine Gete, nor those in Hainaut, contain a defensive structure with walls and ditches. It is possible that only one of the settlements functioned as a central stronghold for the inhabitants of the neighbouring villages (Cahen *et al.* 1990, 142). In that case, we have not come across the fortified settlement(s) along the Kleine Gete. There might, however, also be a chronological explanation for the difference between fortified and non-fortified settlements. According to this hypothesis, either the settlements at Wange and Overhespen were deserted at or even before the time of the hostilities, or they may have been established only after peace had returned. Even though examples of such villages, like Darion and Waremmme, were possibly immediately constructed as a fortified settlement, others, such as Oleye, seem to have added a wall and ditch at a later date (Cahen *et al.* 1990, 137; Jadin and Cahen 1997). The available data would also imply that the fortifications of some of these settlements lost their functionality in a later phase (Cahen *et al.* 1990, 138). This leads to the assumption that a security problem arose after the initial colonisation, and disappeared in a later phase. This implies that the colonisation of the region did not take place in a hostile atmosphere and that the termination of the LBK settlements in central Belgium was not triggered by fatal conflicts.

Who caused the trouble for these LBK settlements is not known. The security problem may have had its origin in internal conflicts, even though the location of these fortified settlements at the periphery of the LBK distribution suggests a conflict with outsiders. It is not clear who formed the threat; were there other local groups, or did people migrate from faraway places? Both options remain open. It is even possible that the inhabitants of the settlements along the Kleine Gete formed a threat for their southern neighbours. Even though we need to be careful with these interpretations, we may at least conclude that the LBK settlements in Hesbaye do not have a straightforward history.

The time period in which we should locate the settlements of Wange and Overhespen remains uncertain. Did they belong to the first expansion phase of the LBK in Hesbaye? Did they not succeed in keeping their position, or were they only settled in a later phase? Typological and C-14 analyses are presently inadequate to come to an unequivocal conclusion. It remains largely uncertain when these settlements were established within the framework of the Belgian LBK. It is also difficult to determine for how long they persisted. The absence of overlapping structures points rather to a short-lived settlement, possibly only lasting for one generation. The circumstances of its termination are also ambiguous: did the inhabitants leave abruptly or gradually? And what were the causes? Did the inhabitants decide to leave themselves, or were they forced by external circumstances? The questions remain unanswered, as is the enigma of what became of these inhabitants.



Figure 9. Aerial photograph of the ditch that partly surrounded the LBK settlement of Oleye. Picture taken on the 11th of March 2007 by Rene Pelegrin (K.U. Leuven).

The successor in this region of the LBK appears to have been the *Groupe de Blicquy*. So far, eight settlements have been found in the immediate vicinity of the LBK settlements in Hainaut (Constantin and Demarez 1997; Deramaix 1997). In addition, habitation and funerary remains of this group were found near two frontier settlements of the LBK in Hesbaye, i.e. at Darion and at Vaux-et-Borset (Cahen *et al.* 1993; Caspar *et al.* 1993; Hauzeur *et al.* 1997). The longhouses here have a trapezoidal plan and the ceramic production is similar to that of the LBK, although bone temper was used. The flint industry also follows the LBK tradition, although local material was being used. Bracelets in schist are typical of this group. The *Groupe de Blicquy*, which was originally confined to Hainaut, apparently had a greater impact than initially expected. At this point in research, however, there are too few indications to conclude that this *Groupe de Blicquy* was also present along the Kleine Gete. Further investigations are needed to shed light upon this question.

To summarise, we may conclude that the three sites at Wange and Overhespen predominantly show LBK characteristics, yet also contain elements which are related to non-LBK societies. It is not clear whether these groups are indigenous in origin or whether their roots are elsewhere. The cultural affinities with the traditional LBK people, together with the chronological relation of these sites with other LBK groups, are currently an issue for debate.

The Early Neolithic Period in Europe: some reflections

Since the sites at Wange and Overhespen were discovered and the excavation data had been analysed in detail, many new discoveries have been made regarding the

origins of the LBK people in Europe and the presence of other non-LBK societies. It is becoming more and more perceptible that western Europe was inhabited by neolithised groups of people other than the LBK, and that these groups of people maintained very close contact with LBK settlements in various different regions. These other groups are represented by Limburg ceramics, La Hoguette ceramics and other pottery assemblages (e.g. *Begleitkeramik*) which can be clearly distinguished from LBK pottery on the basis of their fabric, their shape and their decorative patterns (if present). The relationships between the various non-LBK groups are not yet clear, and we feel that we know too little about them at present to be able to draw any conclusions about their origins, distribution or chronological development. It is also far from clear how the non-LBK people lived, because only very few settlements where they occur as a distinct group have been found. The occurrence of their distinctive pottery in LBK settlements is too rare to shed light on their identity.

The results of excavations at various sites allow us to conclude that these groups were already present in certain regions before the arrival of the LBK culture. It is also clear from the excavation results on different sites that they were able to survive in a relatively independent way even after the arrival of the LBK people. At any rate, judging by pottery found in association with pottery from various LBK phases, non-LBK pottery was not recognizably influenced by LBK pottery, at least not as regards the distinctiveness of the pottery. Apparently, no integration or mutual influences regarding the fabric, shapes or decorative patterns which were used by the two groups, LBK and non-LBK, occurred throughout the whole of the LBK period.

The 'snap shot' picture of this evolution that was presented to us at the Wange and Overhespen sites is in keeping with this general perspective. Here, at the edge of the area of LBK distribution, a period of intensive contact between LBK and non-LBK groups evidently occurred which, although it was only for a short time, was peaceful and productive. There is clear evidence of cooperation and the mutual exchange of expertise, which, more than in other places perhaps, resulted in specific features such as the trapezoidal form of the ground plans of dwellings and the specialized debitage of Wommersom quartzite and lydite.

Nevertheless, it is still difficult to determine the precise relationship between the LBK people and those of non-LBK origin. We find it hard to shake off the impression that contact between the two groups was already well-established at the time of the settlements in Wange and Overhespen and hence did not begin when the settlements were founded. It is possible that more or less intensive contact had already existed for many years or decades, in which case the type of community existing in the settlements of Wange and Overhespen would confirm earlier contact, perhaps in previous generations. We can even ask to what extent the origin of both of these populations still played a role within the communities inhabiting the settlements. It is possible that integration was already well advanced, even though distinctive characteristics of both communities still existed.

Whatever the case, the present elements seem to indicate that these settlements along the Kleine Gete river played a short yet crucial role in the history of contact between LBK and non-LBK groups. Even if we are not able to reconstruct the precise events of the period in question, we hope that further research will shed more light on the relationship between these populations in the near future.

This contribution is a reworked copy of an earlier article, published in 2000 as Marc Lodewijckx and Corrie Bakels, 'The interaction between early farmers (Linearbandkeramik) and indigenous people in central Belgium', in J. C. Henderson (ed.), *The prehistory and early history of Atlantic Europe*, 33-46. Oxford: BAR. The issue of these frontier settlements of the LBK has remained topical in the light of new discoveries made elsewhere in Europe.

Appendix

Carbonised seeds from LBK sites at Wange and Overhespen.

Site	Wange-N	Wange-D	Neerhespen	
number of samples with remains	8	10	16	
Cultivated plants				
<i>Hordeum vulgare</i> var. <i>nudum</i>	1	1	1	naked barley
<i>Triticum dicoccum</i>	1	-	3	emmer wheat
<i>Triticum monococcum</i>	1	1	-	einkorn wheat
<i>Tr. dicoccum/monococcum</i>	3	3	7	emmer or einkorn
<i>Pisum sativum</i>	1	2	1	pea
Trees and shrubs				
<i>Corylus avellana</i>	1	2	2	hazelnut
<i>Hedera helix</i>	-	-	1	ivy
<i>Prunus spinosa</i>	-	-	1	sloe plum
<i>Tilia</i> sp.	-	-	1	lime
Wild grasses				
<i>Bromus arvensis/hordeaceus/secalinus</i>	4	2	3	field, soft or rye brome
<i>Bromus sterilis/tectorum</i>	-	1	-	barren or drooping brome
<i>Chenopodium album</i>	1	6	4	fat hen
<i>Fallopia convolvulus</i>	-	3	2	black bindweed
<i>Galium aparine</i>	-	2	-	cleavers
<i>Galium</i> cf. <i>spurius</i>	-	-	1	false cleavers
<i>Lapsana communis</i>	1	3	4	nipplewort
<i>Persicaria lapathifolia</i>	1	-	-	pale persicaria
<i>Phleum</i> sp.	-	-	2	cat's tail
<i>Stachys sylvatica</i>	-	-	1	hedge woundwort
<i>Rumex</i> cf. <i>sanguineus</i>	-	-	1	red-veined dock
<i>Rumex</i> sp.	-	2	-	dock
<i>Vicia sepium</i>	-	-	1	bush vetch
<i>Indeterminatae</i>	1	3	1	unidentified

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The extreme eastern periphery of the Linearbandkeramik: the landscape and geographical contexts

Olga V. Larina

Being the first of a planned series, the present article summarises the findings on the LBK culture west of the Carpathians, on the territory of present-day Ukraine, Romania and the Republic of Moldova. Research is focused on natural and geographic reconstructions of the area. I will first outline the characteristics of the natural environment in this area, which are extraordinarily diverse. On this basis, it will be possible to show that LBK settlers consistently favoured a certain constellation of variables. I will also briefly outline the relationships between the LBK and other cultural groupings in the region.

Introduction to the study area

The beginning and spread of a producing economy, i.e. agriculture and animal breeding, was of great significance in the history of humanity. The transition to this new economy transformed all aspects of human activity, promoting a new way and manner of living. As a result of the Neolithisation process, Europe received the basic elements of a producing economy ready-made. This process was triggered by influences from western Asia and Anatolia. Neolithisation progressed from south to north, covering first the areas of southeastern Europe, then central Europe and, finally, eastern Europe.

Within these broader trends, the extreme eastern periphery of the Linear Pottery culture represents a relatively independent natural and geographical region bounded by the Carpathian Mountains. Running from north to south, they divide the central European LBK into a western (central) zone and an extreme eastern zone. In present-day political terms, the eastern periphery of the LBK is located on the territory of three states: the western areas of Ukraine, eastern Romania and the central part of the Republic of Moldova. The total area is circa 40–50 thousand square kilometres, in which about 230 sites of the LBK culture are situated.

Geographically, the area extends along the length of the edge of the East Carpathians (longitude 24–25° East) and inland to the east for 200–300 km (longitude 28–30° East), reaching the source of the Goryn river and the left-bank tributaries of the Dniester river. The Carpathians in the west and the Dniester to

the east are the most vivid landmarks of this region. Traditionally, therefore, a broader term is applied to it – the Carpathian-Dniester region (Figure 1).

The northern and southern limits of the eastern area are extremely clear-cut: it is the line between forest steppe and forest in the north (latitude 50°45' North) and forest steppe and steppe in the south (latitude 46–47° North). The correspondence of the culture's boundaries to the edges of the forest steppe area demonstrates the significance of natural factors for the establishment of cultures and for cultural choices.

The Carpathian-Dniester region occupies the southwestern part of the Russian (east European) Plain and is open to the vast spaces of eastern Europe. In the south and southwest, the Black Sea coast and the Danube connect it with the Balkans and the east Mediterranean. A network of mountain tracks and passes link it with the areas of the inter-Carpathian Basin, as well as those along the Tisza river and the Middle Danube. In addition, it is linked with eastern regions of central Europe along the northern end of the Carpathians, through the sources of the Dniester and the Western Bug. The initial settlement of the eastern periphery by LBK communities takes this very direction. In the settlement of this region, each of the designated geographical zones played its role, strongly influencing the processes of both culture formation and disappearance.

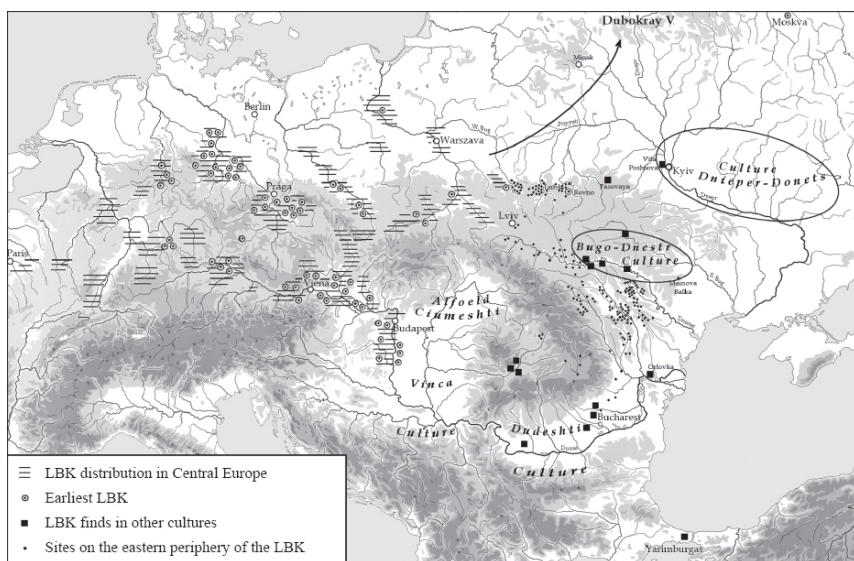


Figure 1. Distribution of the LBK culture in Europe.

On Terminology

When discussing sites of the LBK's extreme eastern periphery, we should specify the terms 'western LBK' and 'eastern LBK'. Both of these cultural-historical phenomena have a common substrate expressed through a similar material culture during the earlier LBK. The changes taking place in the later phases of the LBK led to the rise of two diverging cultural communities with their own genesis and

historical trajectory. As both of them are very large-scale and distinguished by several differing practices and material remains, a geographical influence can be suggested as the basis for their division.

The eastern LBK covers east Hungary, east Slovakia, west Semigradye and a southwestern part of the Ukrainian Transcarpathians. Further influences can be seen in Banat, Malopolska and, in the form of imports, in the southwestern part of Slovakia. This area is characterized by a prevalence of ceramics with drawn geometrical motives and painting. This group includes Barca III, Gemer-LBK, Ciumesti, Szatmár, Alföld-LBK, Kopcany, Tiszadob, Bükk, Szakalhat, and Tisza-Tiszapolgar.

The western LBK extends from the Dniester up to Paris, and from the Danube almost up to the Baltic Sea. Within these limits, one can distinguish between (1) a core region with a classical 'musical note' ornament (the Danube area with Moravia, southwest Slovakia, southeast Poland, west Ukraine, east Romania and the Republic of Moldova); (2) a region with several variants of filling in the 'panel'-bands (the Rhine and the Elbe); the border between these two groups is supposed to be along the Morava and the Oder; (3) the region of Bohemia acts as a territory demonstrating a mixture of the two traditions of the above regions (Rulf 1997, 11).

Terminology for the extreme eastern periphery of the LBK

To make working with the text easier, the following designations are used: 'the northern zone' comprises the sites of Ukraine, located on the territory of historical Volhynia and on the Dniester river. The territory of 'historical Volhynia' includes several regions of modern Ukraine: the Volhynia region (city of Lutsk), the Rovno region (city of Rovno), and parts of Lviv (city of Lviv) and Ternopil (city of Ternopil).

'The southern zone' comprises the sites of Romania and the Republic of Moldova. The territory of 'historical Moldova' covers that of two states from the Carpathians to the Dniester. To differentiate the two Moldovas, the following geographical terms are used: Carpathian-Prut for the Romanian region and Prutian-Dniester for the Republic of Moldova.

Sources

According to our calculations, 226 sites are known at present. Most of them (80) are on the territory of the Ukraine and smaller numbers lie in Romania (77) and in the Republic of Moldova (69). We can confidently assume that the established patterns of distribution in the Carpathian-Dniester are complete and no serious changes concerning the issue are expected in the future. Newly discovered sites are close to those previously known, increasing the settlement density within the limits of the distribution already established. These sites form the basis of the following reflections into the natural and cultural context of LBK settlement.

Geographical description of the region

Various aspects of the life and activities of human societies are to a considerable extent determined by the environment of their settlement. Usually, LBK migrants

tried to keep their traditional farming practices and, therefore, sought out areas which in terms of landscape and climate corresponded to their traditional economy and everyday life. Modern geographers, attempting to characterise these conditions, mainly use the parameters of climate, water supply, relief and vegetation. For LBK agriculture (in the light of modern knowledge, a farming and cattle breeding economy is indisputable), the evaluation begins with the properties and fertility of the land.

The Carpathian-Dniester territory, inhabited by LBK groups, corresponds to the extreme southwest end of the east European plain and can be completely characterised as a wooded steppe environmental zone. Two main factors determine its geographical specifics, the Carpathians in the west and the Volhynia – Podolsk highlands in the east. The corridor they form stretches from north to south for c. 500–600 km and is characterised by uniquely diverse natural and climatic conditions and landscapes.

Covered by woods, the Carpathians and their foothills give way to woody plains to the east. The narrow canyons of the mountain rivers turn into wide water meadows on the plains. The hot and dry climate of the Mediterranean competes with the milder humid central European and continental climate of the east European plain. The further away from the Carpathians, the stronger the continental influence becomes.

The Carpathians

The east Carpathians stretch in a southerly direction. Coniferous and mixed forests cover mountain slopes that are 1,100–1,500 m high, some peaks reaching 2,500 m. Large rivers, such as the Dniester, the Prut and the Siret with their tributaries the Suceava, the Moldova, the Bistritsa, the Trotus and the Putna, originate in the east Carpathians. On the plain, winters are mild, the average temperature being -4°C in January and +18°/+19°C in July. With every 100 m increase in altitude, temperature decreases by 2°C. The reverse is true for rainfall. On the plain the average annual rainfall is 600–800 mm, whereas in the Carpathian foothills it rises to 1,400 mm. The most abundant precipitation, both in the form of rain and as snow melting in the mountains, takes place in the hottest month of July. The rivers and streams fill with water, which also reduces the risk of summer droughts.

In terms of natural and geographical features and concentration of sites, the territory settled by LBK groups is subdivided into relatively independent zones. The northern zone is a territory of historical Volhynia; the central comprises the upper and middle Dniester; while the southern includes the territory of historical Moldova on both banks of the Prut. However, the sites are clustered in groups, one group concentrating in Carpathian-Prut (Romania), the other in the central part of the Prut-Dniester interfluvium (the Republic of Moldova).

Volhynia

Volhynia is a historically established territory in northwest Ukraine. Its southern outlying part contains the line of the main European river watershed. Within the limits of Volhynia, geographers distinguish the Volhynia Upland, the Polesye Lowland and Small Polesye, whose extension on the territory of Poland is called

Liublin Polesye. Polesye (translated as 'woodland') is a forest-clad and water-bearing territory with extremely rich and diverse flora and fauna, where marshy soils and turbaries are widespread. The Polesye Lowland continues into the Pripyat basin with the minimal heights of 134–139 m. Both Polesyes flank the Volhynia Upland to the south and north respectively. The latter is a hilly forest plain broken down by a dense network of rivers, gullies and ravines. With average heights of 240–270 m, it rises to the south and southwest up to 340–372 m in Small Polesye (watershed). Over 420 rivers originate on the territory of Volhynia, 24 of them drain into the Western Bug (the Baltic Sea basin). The others belong to the Black Sea basin, being tributaries of the Pripyat, the Dnieper and the Dniester. In a diverse soil cover, typical podzolized¹ chernozem-like soils stand out, which were formed on loams. It is notable that the location of LBK sites directly corresponds with the chernozem-soil areas.

Upper and middle Dniester

The Dniester is the biggest waterway of the region. It originates in the east Carpathians, in the same place as the San river. They are separated by the Sansky Ridge, directing one river north to the Baltic Sea and the other south, to the Black Sea. The Dniester flows in a deep (up to 150 m) and wide (0.5–1 km) valley, forming numerous meanders and bends. Geologists distinguish several river terraces, the youngest of which was formed in the Holocene. The Carpathian foothills consist of hilly, well-drained ground, ravines and gullies.

The relief of the right bank of the upper Dniester is characterised by lowland with developing terraces. Woodland vegetation and soil types dominate; individual LBK findspots are widely spaced. On the left bank, a flat relief with eroded valleys and karstic formations is more developed. Superficially, the soil cover is turf-podzolic, as gleen soils predominate. Oak and beech forests alternate with forb meadows².

Given its physical and geographical conditions, this region can be described as a wooded zone with deciduous forests and grass meadows. Wooded-steppe landscapes are formed on the left bank, while on the right bank, they consist of a very narrow strip, which broadens in the middle of the river's course. Consequently, LBK sites are more numerous on the mid-course stretch of the river and on its left-side tributaries. Grey and light-grey wooded soils dominate, while in the river valleys and on the flat plateaux there are chernozems.

Romania and the Republic of Moldova

The relief of this region is extremely diverse. In the foothills of the Romanian Carpathians, the Pre-Carpathians, there is a range of basins with a temperate-continental climate. To the east, basins are replaced by the elevated hilly plateaux of Suceava and Barlad with average heights of 300–400 m. The closer one gets to the Carpathians, the colder it is. The climate of the Suceava plateau is colder and more humid, whereas that of the Barlad plateau, which is more to the southeast, is warmer with less precipitation.

To the north, the plateaux of Suceava and Barlad adjoin the hilly areas of woody Bukovina (Ukraine) and the north Moldavian Plateau (the Republic of Moldova).

In the east, in the Pre-Prut zone, they extend into a plain – Podisul Moldovei, whose relief is softly undulating with dominating heights of 200–300 m, but dropping down to 30–90 m in the floodplains of the Prut and its tributaries. In outlying parts of the Barlad plateau, there are wooded-steppe landscapes and chernozem-like soils. The steppe has penetrated into the woods and formed a wooded-steppe plain and droughty Pre-Danubian steppes (Figure 2).

Further to the east, from the Prut to the southern Bug, lowland wooded-steppe landscapes prevail. The landscape is only slightly hilly, but although the dominating elevations are not very big, the strong vertical breakdown makes the relief of separate parts look mountainous. The most prominent uplands are located in the lower course of the Dniester – Low-Prut, Codru and Pre-Dniester. They are a maximum of 200–300 m (470 m in the Codru) and a minimum of 110–115 m high (Figure 2).

The biggest rivers – the Siret, the Prut and the Dniester – and their tributaries cover the greatest part of the drained territory of the area's southern periphery. The overwhelming majority of sites are located in their basins. Chernozems take up most of the territory of the southern area (up to 70 %) and are bound to the relief's middle layers, not exceeding 250 m. They were formed on various rock strata under cereal-grass meadow steppes. The chernozems of the extreme eastern area are characterized by high natural fertility. Their actual age in Ukraine and in Moldova is 8–9 millennia (Krupennikov 1992, 70). Wood soils are found on heights exceeding 250–300 m. The formation of modern floodplain sediments in river valleys dates to the early Holocene.

Within the limits of the area's southern part, there is a border of four botanic and geographical areas: east European deciduous forest, European deciduous forest, Mediterranean forest and Eurasian steppe. The flora contains numerous west European and rare Mediterranean species, many of which are not found eastward on the Russian plain, e.g. beech (*Fagus silvatica* L.), black poplar (*Populus nigra* L.), oriental hornbeam (*Caprinus orientalis* Mill.), fluffy oak (*Quercus pubescens* W.), wild grapes (*Vitis silvestris* L.) and pear (*Pyrus elaeagrifolia* Pall.).

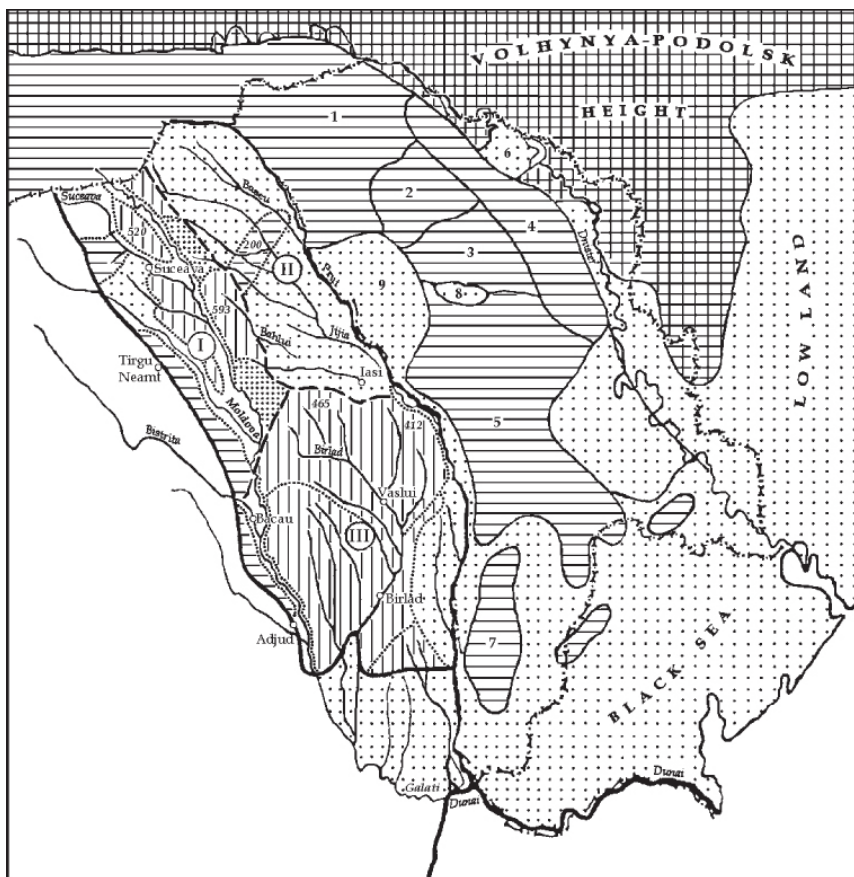


Figure 2. Orographic scheme of the southern part of the Carpathian – Dniester region. Romania: I. Plateau of Suceava; II. Lowland of Moldova; III. Plateau of Birlad. Rep.

Moldova: 1. North Moldavian Plateau; 2. Low-Cubolta Plateau; 3. Ciuluc-Solonets Plateau; 4. Pre-Dniester Upland; 5. Codru Upland; 6. Camenca Lowland; 7. Lower Prut Upland; 8. Cula Lowland; 9. Middle Prut Lowland.

Climate in the Carpatho-Dniester area

The climatic features of the eastern area of the LBK are extremely favourable for human life. The climate is temperate-continental. For the north zone (Volhynia and the Dniester), the average annual temperature is 4° – 5.7°C , with a January average of 4° – 6°C and a July average of $+18^{\circ}$. The period during which temperatures reach $+10^{\circ}\text{C}$ covers 160 days. Annual rainfall is 600–650 mm.

In the southern zone of the area (Romania and the Republic of Moldova), the climate in general is transitional between the oceanic climate of western Europe and the continental one of eastern Europe. The nearness of the dry hot climate of the Mediterranean reduces the negative effect of the continental east European climate. There is an abundance of sun and the winter is mild. Average annual

temperature is 7.5°–10°C, which makes winter unstable, with scarce snow. The January average is -3°–5°C and the July average +19.5°/20°–+22°. Annual rainfall is 400–550 mm, with most precipitations of 500–550 mm in the north and northwest. In the central zone, it is 400–450 mm. To the south, the rainfall quickly decreases to 350–300 mm.

Correspondingly, the temperature parameters show a substantial increase (by +3°/+4°C) within the region from the north to the south (Volhynia – Moldova). The parameters of moisture provision are as follows: average indices for Volhynia of 600–650 mm rise to 600–800 mm in the Dniester zone. Then they sharply drop to 400–450 mm in the southern part of the area, reaching a critical minimum of 327 mm in the steppe zone in the south.

However, their temporal distribution coincides with the basic cycles of plant vegetation: the largest monthly precipitation (60–80 mm) falls in May–June, the smallest (27–37 mm) in January. The minimum number of days with precipitation is registered in September, which is harvesting time. The stable combination of the three factors climate, humidity and soil is a cornerstone for the success of agricultural activity in the southern part of the area.

Landscape and climatic reconstructions in the Carpathian-Dniester region: palynology

Neolithic development in the Carpathian-Dniester area (second half of the 6th – end of the 5th millennium B.C.) lies within the Holocene Atlantic period. It is traditionally characterized as a climatic optimum with a warmer and more humid climate. These data are confirmed, and in certain cases amended and complemented, by palynological research. In terms of territory, the investigations coincide with epicentres of site location on the territory of Volhynia, the Sub-Carpathian zone of Romania and in the Prut-Bug interfluvium. Actually, the investigation has covered the entire area. In my opinion, the most important results have been achieved for the earliest, initial stage of the LBK. Moreover, they can be compared with contemporary data for the southern zone of the periphery, settled by the late Criș culture, as shown by the type site of Sacarovca I (Republic of Moldova) (Figure 3: 39).

New reconstructions of middle Holocene climate on the basis of the palynology of the coastal sediments of the Dniester (6960 ± 70 BP (КИГН-360), and diagrams of cuts from Sacarovca I (6650 ± 100 BP (Bln 2425) 5480–5440 cal BC) demonstrate that at the end of Atlantic-I a short-term aridisation of the climate occurred in Moldova. The rainfall was less than now, while the temperatures were higher than today (Medeanic and Larina 2002, 550–57; Levkovskaya *et al.* 2003, 307–11; Larina and Medeanic 2004, 12–27). As far as we know, Sacarovca I is contemporary with the earliest LBK.

For Volhynia, the earliest evidence for agriculture comes from cerealia spores, and a ruderal increase is recognised from a study of spore-pollen complexes from the Starniki bogs on the territory of Small Polesye near Rovno and from Lukcze bog in neighbouring Lublin Polesye in Poland (Balaga 1982; Bezusiko and Kotova 1997, 140–43). The comparison of results shows a high degree of similarity in the structure of the woodlands and the basic tendencies of their development. The materials are contemporary with the earliest LBK and dated to the beginning of

Atlantic-2 (Table 1). The investigation proves an aridisation of the climate, as no increase of rainfall was observed with the rise in temperature. The July temperatures are higher by circa 1°C, those of January by 0.5–1° and the annual ones by 0.5–1°C. Rainfall was lighter than at present by 25 mm. Therefore, earliest LBK communities in the territories of Poland and Ukraine, as well as the Criș population of the southern zone of the area, lived and developed their economy in almost similar palaeoecological conditions.

This data set is extremely important for understanding both the ecology of the earliest phases of agriculture east of the Carpathians and the process of the disappearance and emergence of cultures. The bearers of the Criș III–IV culture, in the course of their movement to the southeast, settled a territory which in natural and climatic aspects is similar to their area of origin.

Settlements in Hungary tend to be located near the Tisza and Körös rivers. The vegetation here is steppe and wooded-steppe with chernozem soils, as in the southern zone of our area. However, in Hungary they are located in the hottest part of the country. It can be suggested that climate aridisation at the end of Atlantic-1 and the beginning of Atlantic-2 triggered the search for new territories both northward and southeastward of the epicentre of the Criș culture. It could also have promoted the transformation of the culture's materials to the Szatmár group.

We should specially emphasize that the kind of agriculture practiced by the most ancient European community of the early Neolithic (Preseskle-Starčevo-Kremikovtsy I – Karanovo I^aII – Criș) was developed on the alluvial plains and dry foothills of the east Mediterranean and the Balkans. This can explain the existence of similar agricultural practices in the southern zone (during phases of dry climate), probably up to the appearance of the 'musical note' phase of the LBK.

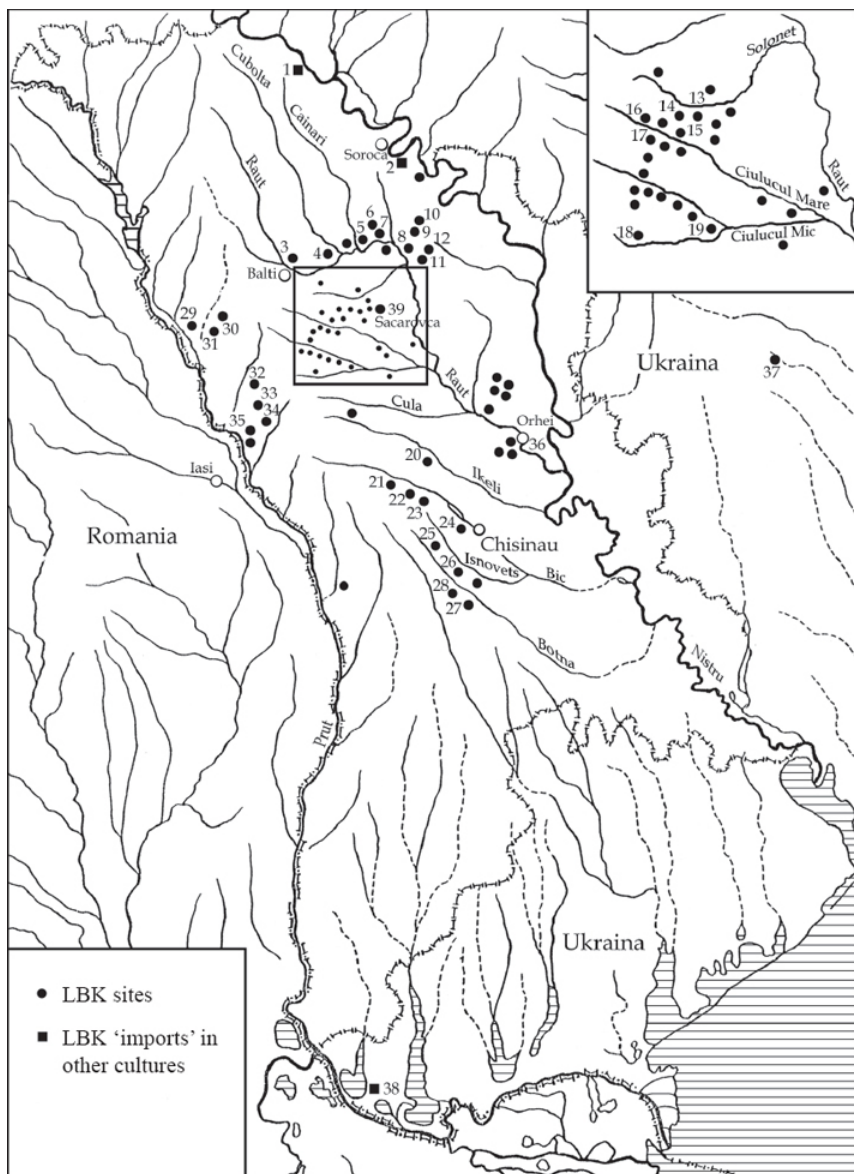


Figure 3. Location of LBK sites in the Republic of Moldova. Sites mentioned in the text: 1. Tatarauca Noua XV; 2. Soroca V; 3. Balti; 4. Cubolta; 5. Marculesti; 6. Floresti I; 7. Floresti II; 8. Gura Camencei VI; 9. Gura Camencei VII; 10. Gura Camencei X; 11. Tira II; 12. Rogojeni II; 13. Singerei XI; 14. Singerei VIII; 15. Singerei I; 16. Biliceni Vechi I; 17. Biliceni Vechi XI; 18. Coscodeni I; 19. Mandresti; 20. Greblesti; 21. Panasesti I; 22. Straseni X; 23. Straseni XI; 24. Durlisti; 25. Scoreni; 26. Danceni I; 27. Rusestii Noi I; 28. Rusestii Noi II; 29. Moldoveanca I; 30. Moldoveanca II; 31. Navirneti; 32. Radenii Vechi I; 33. Radenii Vechi II; 34. Rezina I; 35. Rezina II; 36. Orgeev palaeolake; 37.

The northern zone

For the northern zone, the same climatic changes at the turn of Atlantic-1 and Atlantic-2 encouraged the earliest LBK communities to settle this region. Their emergence within the limits of the eastern periphery of the culture is part of a uniform process. They moved to the source of the western Bug, where they are represented in Grodku Nadbuznym (Figure 4: 1) (Kulczycka-Leciejewiczowa 1979, 51), then appeared on the Ustea river, a tributary of the Goryn' river near Rovno. The established environment supported population movements to the source of the Vistula, to the Baltic Sea, up to Boguszevo 41 (Table 1) in Poland (Hallgren 2004, 137–40).

Moreover, modified material of Dubokray V type, or 'earliest – early later' LBK, appears on the Lovat river in the West Dvina basin, in a wooded zone of the Smolensk region in Russia. The date of the existence of this type is correlated with the arid period of regression 2. At present, these archaeological remains are only found at the bottom of the lake. According to the range of C14 dates for this period in the study area (see 'other dates' in Table 1), Dubokray V materials fit, with a small delay, into the general context of the 'early' to 'early late' LBK of the eastern periphery (Miklyaeu 1995, 11, 15–19). The abundant water sources of all of these northern territories must have counteracted the negative consequences of aridisation, creating especially favourable living conditions.

The development of the LBK in Volhynia un-problematically continues to the stage of 'later' LBK. Practically immediately, within the earlier phases of the culture's existence, the settlement of the area along the Dniester river begins and the first forays into the southern zone of the area take place.

The southern zone

For the southern zone, palynological investigations were carried out on sites of the middle and late LBK. Entirely favourable natural and climatic conditions were identified (Marinescu-Bilcu *et al.* 1981, 7–31; Kremenetski 1991, 153–55; 2003, 12–15). The average January temperature was 1°C higher than at present, and general precipitation was also somewhat higher (by approximately 100 mm). This is due to some increase in rainfall and/or a decrease of average July temperatures.

In the Prut-Dniester interfluvium, an investigation was carried out by K.V. Kremenetski covering practically the entire central and southern zone of the Republic of Moldova. It included the settlements of Floresti I, Danceni I, Rusestii Noi I and II, as well as the sediments of the Orgeev palaeolake (Figure 3: 36) on the border between the wooded steppe and the woods along the southern extremity of the Codru Upland (Figure 3: 6, 26–28; Figure 5).

It was established that the Floresti region is located in the Balti bunchgrass-cereal steppe. The spore-pollen diagrams indicate the presence of wooded steppe with broad-leaved forests. The latter consisted mainly of lime (*Tilia*), elm (*Ulmus*) with oak (*Quercus*), hornbeam (*Caprinus*) and oriental hornbeam (*Caprinus orientalis* Mill.), guelder-rose (*Viburnum opulum*) and hazel (*Coryllus avelana* L.) in the undergrowth. Among the grasses, the share of compositae, mainly aster, was

high. The comparison of data from Floresti I and the Orgeev palaeolake led me to believe that during the Holocene Atlantic period, the territory of the Balti steppe was much smaller. Wood and wooded-steppe formations encroached onto it, as shown by the essential difference in the environment to the north of Codru (Figure 5: 5).

Another situation is demonstrated by the data for settlements south of the Codru Upland, in the southern part of the Prut-Dniester interfluvium, near Chisinau. Here, the sites are located within the limits of the south Moldavian wooded steppe, bordering on the steppe (Durlesti I, Danceni I, Rusestii Noi I) (Figure 3: 24, 26, 27). During their existence, there was meadow steppe vegetation dominated by dicotyledonous motley grass and a significant share of compositae among the grasses. Representatives of the aster family and wormwood played an important role, with alder growing along the rivers. In the southeastern outlying part of the Codru, there was wood on watersheds, consisting of elm, oak, hornbeam, hazel and oriental hornbeam in the undergrowth. Steppe vegetation was located in river valleys.

In the wooded steppe valleys of the Prut and the Dniester, woods consisted of oak, hornbeam, linden and elm, with ash (*Fraxinus excelsior* L.) and wild grapes also growing there. Alongside woods, there were patches with cereal-bunchgrass meadow-steppe vegetation. A reconstruction of the vegetative cover of the Dniester-Prut interfluvium is presented in Figure 5. In the interfluvium of the Dniester and the southern Bug, there was a meadow wooded steppe with mesophyte grass cover and woods of oak, linden, elm and other deciduous breeds (Bezusiko *et al.* 1988, 125–35).

Finally, it should also be mentioned that the presence of LBK sites east of the Carpathians in itself confirms the existence of favourable natural and climatic conditions in the area. The system of riverways, which constitutes a natural condition for the development of transport and communication, was extremely important for LBK communities. The general diversity of the environment promoted the development of agriculture and the creation of grazing reserves for cattle breeding, while the presence of woods stimulated hunting.

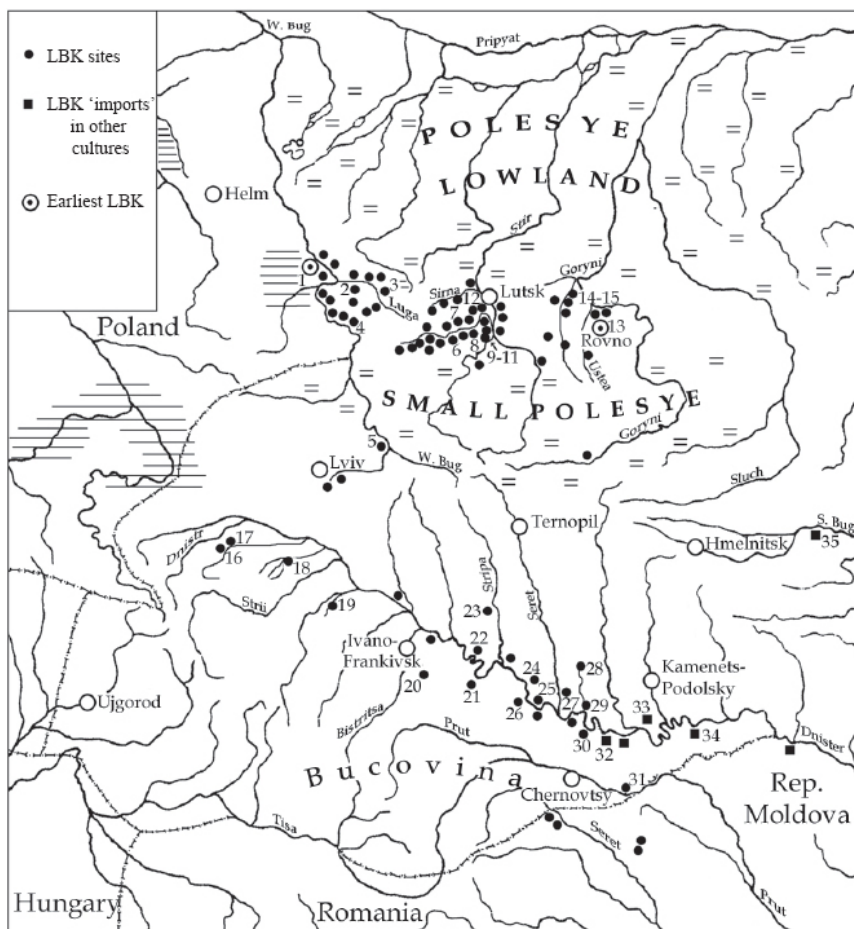


Figure 4. Location of LBK sites in Poland and Ukraine. Sites mentioned in the text. Poland: 1. Grodec Nadbuzny. Ukraine: 2. Zimne; 3. Marcostav; 4. Zastavne; 5. Tadan; 6. Girca Polonka; 7. Baev; 8. Golishev; 9–11. Novostav I, II, III; 12. Lutsk – Gnidava; 13. Rivno; 14–15. Zoziv I, II; 16–17. Kotovane I, II; 18. Kolodnitsa; 19. Korchivca; 20. Markivtsi; 21. Nezvisco; 22. Luca VII; 23. Buchach; 24. Torskoe; 25. Zaleshchiki; 26. Strilce; 27. Bilice Zlote; 28. Jabluniv; 29. Siniciv; 30. Vasiliev; 31. Novoselitsa; 32. Corman; 33. Jvanets; 34. Perebicovtsy; 35. Bazicov island.

Table 1. Selected radiocarbon dates from the study area. Dates cal BC are given at 95.4% probability. Calibration was carried out using the OxCal 3 programme.

Site	Radiocarbon date (cal BC)	
Starobuzyn	6830–50400	
Lutsk	6820–6450	
Bogdaniv	6810–50500	
	6820–52000	
Othmaniv	6820–5050	

5380-4930		
5230-4960		
3990-4660		

Studying the LBK in the Carpato-Dniester region

From the first finds, investigations and interpretations, the study of the area developed in parallel to a Europe-wide interest into antiquities of this type. Here, in accordance with the emphasis of the article, I primarily focus on the geographical interpretations in the area. Initial investigations into the LBK were carried out in the territory of west Ukraine. The first indications of an LBK presence to the east of the Carpathians became evident in the late 19th century, and the period 1920–40 marked an active stage of data collection. In Volhynia and the Dniester area, the investigations of Polish (W. Antonewicz, L. Kozłowski, J. Fitzke) and Ukrainian (J. Pasternak, A. Tsingalovsky) archaeologists revealed 13 sites. Even then, they roughly outlined the whole future area of the culture on the territory of modern Ukraine: Lutsk and Baev in Volhynia (Fitzke 1938, 26; Kozłowski 1939, 97–103), Torskoye (Antonewicz 1921, 40), and Nezvisco (Kozłowski 1930, 12–16) on the Dniester. R. W. Hutchinson and J. P. Preston took part in the Nezvisco excavation (Hutchinson and Preston 1930).

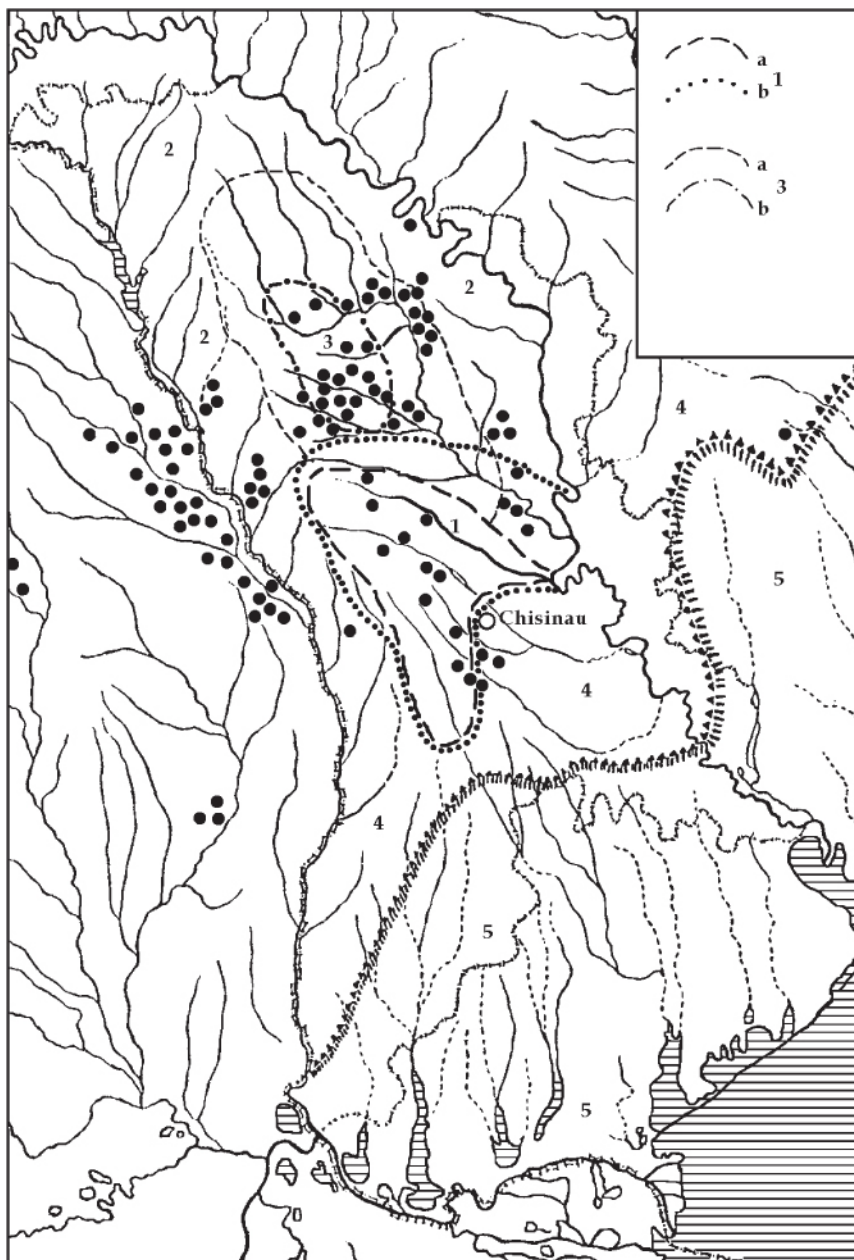


Figure 5. Schematic reconstruction of vegetation in the Prut-Dniester interfluvium area. 1. The broad-leaved forests of the Codru territory (*Caprinus*, *Ulmus*, *Quercus*, *Tilia*): a – modern limits, b – reconstructed limits. 2. The forest-steppe with *Ulmus*, *Tilia* and *Quercus*, *Caprinus Orientalis*. 3. Balti steppe: a – modern limits, b – reconstructed limits. 4. Cereal-grass meadow steppe. 5. Steppe of the Black Sea Lowland.

The finds were attributed to the LBK culture, which by that time was already well enough known in central Europe as *Bandkeramik* (Klopfleisch 1884, 92), *Volutova*, *Spiralmäanderkeramik* or *Spiralband* (A. Schliz, K. Wilcke, J. Boehlau), while G. Childe (1929, 25, 28) named it Danubian. W. Antonewicz, on the basis of works by Czech and Polish scholars, pointed out the alien nature of the culture and outlined the possible migration route of its bearers. According to him, they had moved from the area of the Mid-Danube along the Morava to the Czech Republic and further across Moravia to Poland (Krakow, Keletz, Sandomir), from there eastwards along the Vistula and the Kuyava, and then from the San river to the upper Dniester (Antonewicz 1921, 79–91). V. Milojcic used the pre-war data on the sites of west Ukraine to determine the LBK settlement boundaries and the time of its arrival in eastern Europe. Galicia was included in the LBK area. For the first time, researchers paid attention to late Jeliz features of ceramic ornamentation from the settlement near Lutsk (Milojcic 1951, 111–16).

Historically, LBK evolution was connected with the question of the origin of the distinguished Eneolithic Tripolie culture (now Cucuteni-Tripolie). Researchers considered that “the Tripolie culture in its significant part was only a result of further development of the *Danubian* culture” (Krichevskii 1940, 50; Passek 1949, 30; Childe 1952, 206). It should be pointed out from the start that the concept of LBK participation in the establishment of the Tripolie culture was fruitful. However, this participation was very remote in time and complicated by additional factors which participants in the discussion could not yet know about.

The second half of the 20th century was the period of most intense activity in archaeological investigations in the whole area of the eastern periphery. Beginning with the 1950s, the source fund *ceramica liniara* begins to be created on the territories of both Romania and the Republic of Moldova. This period can be conventionally divided into decades, as every ten years there was a generalisation of rapidly increasing data. The investigations carried out in Ukraine increased the number of explored sites up to 80. They raised the site density of the area, which had been outlined by the researchers of the first half of the 20th century, and constitute the main part of the data set (Figure 4). Extremely important are the sites which register the direction of settlement of the southern zone of the area, from the Mid Dniester (Vasiliev) to the source of the Prut (Novoselki) (Figure 4: 30–31) (Timoshuk 1970, 11).

Ideas and collection of information concerning the LBK were especially dynamic in Volhynia. In the 1970–80s, the works of G.V. Ohrimenko and the geologist V.K. Pyasetskii revealed about 20 new sites. Among them, the most ancient earliest LBK site near Rovno is of special value, as it is the first in the Carpathian-Dniester area (Figure 4: 13) (Pyasetskii and Ohrimenko 1990, 69–72; Ohrimenko 1994; 2001).

Studying the culture on the territory of Romania went hand in hand with its investigation in the Ukraine and the Republic of Moldova. E. Comsa numbers 24 cultures for the Neolithic and Eneolithic periods (from the 8th – early 4th millennia B.C.). This phenomenon of cultural diversity is to some extent predetermined by the existence of various local natural-geographical zones within the limits of the Carpathian-Prut region (Comsa 1982, 19–22). The LBK occupies a significant place in Neolithic cultural genesis; the first data about *ceramica liniara* on the territory of Moldova and Transylvania dates back to the 1930s, becoming part of the scientific revolution in the 1950s. Nestor (1951, 17–26) summed them

up and suggested a northern way of LBK expansion, from western Ukrainian regions to Romanian Moldova (Vlassa 1959, 239–45). At present, we know about over 70 sites with such finds (Figure 6). They are mostly concentrated in Romanian Moldova, reach as far as southeast and central Transylvania, and also into southwest Muntenia and Oltenia. Excavations were carried out on ten sites, mostly in the 1950–80s (as well as in Ukraine and the Republic of Moldova).

On the territory of the Republic of Moldova, about 69 new sites were revealed by the 1990s, the initial stage being connected with V.I. Markevich's activity. In the early 50s, he started investigating the first sites in the southern and central zones of the Republic of Moldova – Rusestii Noi I, II; Floresti I and Tira II (Figure 3: 6, 11, 27–28) (Markevich 1973, 27–37). Especially significant are his joint works with T.S. Passek (Moscow) on the settlement of Floresti I (excavated 1956–63). Here, a Tripolie layer (of Larga-Jija – Precucuteni II type) was above the layer with LBK materials. For the first time, the relative sequence of these cultures was established in the region. Floresti I became the *terminus ante quem* for the latest LBK in the Pruthian-Dniester area (Passek 1959, 329–31). Simultaneously, E.K. Chernysh studied the settlement of Nezvisko in Ukraine (Chernysh 1962, 5–26) and joint research work made it possible to reflect on the whole range of LBK research problems in practically all aspects. The bearers of LBK ceramics appeared in the Carpatho-Dniester area, moving there from central Europe. Based on the materials from Romania, the authors determined the place of the LBK in the relative periodisation. The LBK follows the Criş culture, precedes the Boian culture and coexists with the Bug-Dniester culture in the late stages of its development (Passek and Chernysh 1963).

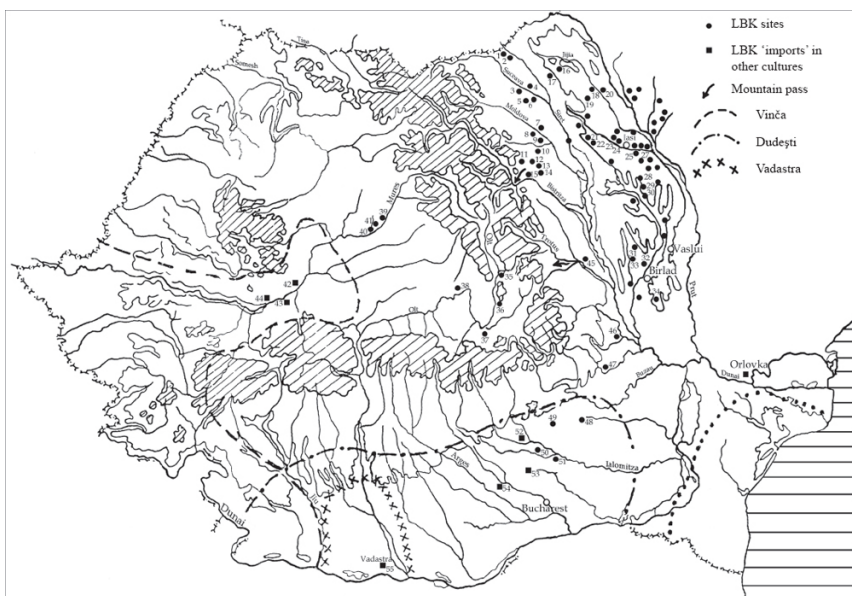


Figure 6. Location of LBK sites in Romania. Sites mentioned in the text: 1. Siret I; 2. Siret II; 3. Parhauti; 4. Mihoveni; 5. Suceava I; 6. Suceava II; 7. Baia; 8. Oglinzi; 9.

Lunca; 10. Tarpesti; 11. Poiana; 12. Negresti I; 13. Negresti II; 14. Gigoesti; 15. Traian; 16. Braesti; 17. Vilcele; 18. Pogoresti; 19. Doina; 20. Glavanestii Vechi; 21. Crivesti I; 22. Crivesti II; 23. Letcani I; 24. Letcani II; 25. Iasi I; 26. Iasi II; 27. Valea Lupului I; 28. Valea Lupului II; 29. Danesti; 30. Vulturesti; 31. Tomesti; 32. Perieni; 33. Podu Petris; 34. Baresti; 35. Bancu; 36. Turia; 37. Harman; 38. Rupea; 39. Moresti; 40. Cipau I; 41. Cipau II; 42. Alba Jijia; 43. Tartaria; 44. Turdas; 45. Bratei; 46. Voetin; 47. Vadu Soresti; 48. Suditi; 49. Ginoaică; 50. Lacu Turcului; 51. Cosereni; 52. Vucov; 53. Cernica; 54. Dudesti; 55. Vadastra.

We should note that in the 1970s, these two researchers followed the Romanian scientists N. Vlassa and E. Zaharia (Vlassa 1959; Zaharia 1967, 25) in suggesting that there was another way of settling the Carpathian-Dniester interfluvium. They alleged that LBK groups had moved from the southwest through Transylvania, and then from there to the source of the Siret and to the Mid Dniester (Passek and Chernysh 1970, 117). As a result, a new chronological division of sites was suggested – the division into later Ukrainian (Nezvisco, Torskoje, Lutsk) and earlier, basically Moldavian (Floresti I, Tira II) LBK sites. However, it was mistakenly not considered that LBK sites were non-existent in west Romania and southeast Hungary. Scanty remains had been left in east Transylvania by LBK people, who had reached the area from Romanian Moldova via the Carpathian passes. Later, with the expansion of the study base, such suggestions were proved to be inaccurate.

This was facilitated by an enormous investigation into the Danceni I settlement (3,000 sq. m) and a collection of ceramics of more than 10,000 units, which can be paralleled with Floresti I. On the materials of Danceni I, I perfected the methods of studying LBK ceramics and established significant criteria (Larina 1983, 88–110) which were later used to study collections from all sites. This allowed the introduction of a new internal stratification of the culture on the territory of the Republic of Moldova (Larina 1988, 1–21; 1999, 100–01). These developments correspond to the current state of LBK studies in the Republic of Moldova. They constitute the basis of the present article, which, therefore, has a certain information bias to the southeast.

Cultural context

The Starčevo-Criș culture and its significance for the Neolithisation of the Carpathian-Dniester region

The most ancient ethno-cultural community of southeastern Europe, formed by the cultures of Preseskle – Starčevo – Kremikovtsy I – Karanovo I–II – Criș, took shape approximately in the early 6th millennium B.C. This community gave rise to hoe agriculture with its characteristic cultural corollaries, typical for the alluvial plains and dry foothills of the eastern Mediterranean and the Balkans. During the first half of the 6th millennium B.C., this community extended over a vast territory from the eastern parts of former Yugoslavia to the east Carpathians and from northern Thessaly and southern Bulgaria to northeast Hungary. At the northern periphery of this culture, and in its final stages of development, a specific local variant of the Criș culture emerges in the Upper Tisza area, represented by sites of the Szatmár group or the most ancient Alföld LBK group. The bearers of these

traditions came from central Transylvania and the Tisza's source far to the east into areas of the upstream and middle course of the Siret and the Prut rivers. The origin of the Criș sites of Moldova, located on both banks of the Prut and up to the Dniester, are definitely also related to this group of Szatmár tradition.

To the west, in the middle course of the Danube, the most ancient horizons of the earliest LBK start to be formed by the mid 6th millennium B.C. Its spread brings about the appearance of producing forms of economy further north, in central, western and eastern Europe. The movement of bearers of the Criș culture into the eastern periphery of the region and their further spread resulted in the emergence of new progressive forms of economy in the area. Its standard site in the present-day Republic of Moldova is Sacarovca I (Figure 3: 39) (Dergachev *et al.* 1991). Cultural interactions with local late Mesolithic tribes in the Dniester area and the Bug area brought into existence the new Bug-Dniester Culture (BDC) (Figure 1). Geographically, two local variants can be distinguished: that of the Dniester and that of the southern Bug. Their development has been tracked for about 1000 years in five chronological phases (Danilenko 1969, 46; 1985; Markevich 1974; Markevich and Dergachev 1987, 41).

The main peculiarity of the BD culture is its syncretism, conditioned by contacts with or the participation of various components in its genesis. These are different for each period, initially being local Mesolithic. Judging by mutual ceramic imports and by radiocarbon dating, phases 2 and 3 of this culture coincide in time with the development of the Criș culture in the mid-Dniester area. By this time, the bearers of the earliest LBK appear in Volhynia and the process of their cultural evolution begins; the event is dated to the 6th millennium B.C. There are also interesting parallels between sites of the BDC and LBK sites in Romanian Moldavia, such as the use of semi-subterranean dwellings with exterior ovens (Dergachev *et al.* 1991, 3, 7). In phase 4 of the BDC, a change of cultural priorities can be registered. Elements of the east Dnieper and Donetsc Culture (DDC) dominate in the materials. Long-standing and close acculturation processes with the Criș culture are interrupted as the latter is absorbed into the LBK. In this phase, BDC ceramics seem to stress independence from these new traditions through the use of pottery with shell temper and pointed bases (Dergachev *et al.* 1991, 14f). Finally, phase 5 of BDC development in the Dniester area is simultaneous with middle and late phases of the LBK's existence in the area. This dates to the late 6th–early 5th millennium B.C. The significance of this culture for resolving LBK – related issues consists in the fact that the BDC was actually the only eastern neighbour in whose materials there was distinct evidence for contact and interaction of the two cultures over time.

The Vinča culture and the earliest LBK

Simultaneously with the development of the peripheral Starčevo-Criș in the Carpathian-Dniester area, the break-up of the once relatively united early Neolithic community begins in southeastern Europe. The Starčevo culture is replaced by the Vinča – Turdash community found in former Yugoslavia, the Banat, the lower reaches of the Tisza and central Transylvania. The emergence and genesis of the early LBK takes place in this period of transition from late Starčevo to early Vinča (Quitta 1960).

Of special significance for the study of this cultural period are materials from

western Hungary and southwestern Slovakia. Here of all places, in the western part of Transdanubia, in the Carpathian Basin, the earliest LBK was formed. In western Slovakia and eastern Bohemia, the centre of crystallisation of the LBK, its evolution has been traced in 3–4 phases (Pavúk 1980; 1994; 1996; Zápotocká 1993; Bánffy 2004).

In the later stages of the earliest LBK, its communities moved across central Europe almost instantly. The settlement of the northern part of the extreme eastern periphery took place at the same time, which is indicated by a settlement near Rovno, Ukraine. It is worth remembering that the southern part of the area, corresponding to the territory of Romania and Moldova, was at that time populated by bearers of the latest Criș (IV) = Ciurmești – Szatmár – Alföld, which refer to the eastern LBK. The cultures within the two areas developed in parallel. Only afterwards, in the later LBK period, were both parts of the eastern periphery united in a uniform development.

LBK sites in their landscape settings

Height above sea level was recorded for 208 sites. In the area, they are located at heights of 30 to 480 m above sea level and are hence found both in the lowland and on higher ground. The two locations are equally well represented: 51% of sites (106) are situated in lowlands ($h > 30$ –180 m), 49% (102) on heights ($h > 180$ –480 m). Within the higher ground category, a further zone of the highest ground was distinguished ($h > 300$ –480 m). 26 out of 102 sites, i.e. 13%, are located at this height. When a place for settlement is chosen, closeness to waterways seems to be significant. Watercourses may have served as means of communication between sites and groups of sites. This is certainly true for LBK groups, who preferred to settle on the banks of small rivers and streams that ran into big rivers, just as paths lead to roads.

Volhynia

The 57 sites of the Volynsk Upland form a single region with those in Poland – the area of the interfluvium of the Vepsh and the western Bug. The principal zone of their location is a narrow, 45–20 km wide strip, stretching 220 km west to east from the Vepsh to the Ustia near Rovno. They are located at 190–230 m above sea level (mainly at a height of 200–220 m) with a clearly preferred settlement location: the sites are bound to streams, rivulets and small rivers forming the basin of large rivers. Based on this principle, three concentrations can be distinguished: (1) the western Bug basin (over 24 sites – 30%); (2) the Styr basin near Lutsk (29 sites – 51%); (3) the Goryn basin near Rovno (10 sites – 17%) (Figure 4). Centres of concentration are at a distance of 60–70 km from one another, each of the concentrations having relatively similar patterns.

The earliest site of this zone, the settlement of Rovno, is within the limits of the Rovno Upland (a component of the Volynsk Upland) at 220 m above sea level, near the source of the Ustia, a tributary of the Goryn (Figure 4: 13). The earliest LBK site nearest to it, Gradek Nadbujanski, is located 160 km to the west, on the left bank of the western Bug. Both sites in this area are the first, formative signs of LBK settlement. Their location in a way marked the extreme boundaries of the

ideal conditions for the development of their type of farming. The area of the Volynsk sites exactly fits these limits.

The indisputable centre of the area is the concentration of 18 sites on the Chornoguzka, a tributary of the Stir. 14 of them are located on a 12 km stretch of river near Lutsk, some of them being separated by only 0.5–1 km distance. This part is archaeologically best investigated, based on the sites of Baev, Golishev, Girka Polonka and Lutsk-Gnidava (Ohrimenko 2001, 25–51). They mark the water meadow settlement during the early phases of the later LBK (Baev, Golishev and Girka-Polonka) and the latest phase with Jeliz features (Gnidava) (Figure 4: 6–12).

Sites on the Dniester river

There are 23 sites in the Dniester basin, predominantly located in the middle course of the river. On its upper course, there are much fewer (4), which are located on the lower courses of its mountain tributaries, the Bistritsa, Strii and Svicha (Kotovane I and II, Kolodnitsa, Korchevca) (Figure 4: 16–19). Their height above sea level is 250–300 m. Their emergence is connected with population migrations from the territory of Poland, as well as from the source of the San river, to the Dniester. The Kotovane II collection of ceramics and flint demonstrates certain differences from the Volhynia materials.

The sites on the middle course of the river are numerous (19) and located directly on the banks of the Dniester and its left-side tributaries. Mostly, the lowlands near the water meadows (160–170 m high) are settled (Vasiliev, Zaleschchiki, Strilice) (Figure 4: 25–26, 30), or high water meadows (5–6 m above the water level) in the foothills of the plateau (Nezvisco, 185 m) (Figure 4: 21). It is rarer for settlements to reach higher elevations (250–300 m) on the plateau, on the sources of rivulets and streams originating on the Podolsk Upland (Buchach, Bilice Zlote, Iabluniv) (Figure 4: 23, 27–28). Besides, we can distinguish concentrations of sites on both banks of the Dniester and its tributaries. These clusters are constituted by Nezvisco-Luka-Buchach; Zveneachin-Zaleschchiki-Torskoe and Vasiliev-Bilice Zlote-Iabluniv (on the Siret), the distance between them being 40 km and 10 km along the river respectively.

From Sinikiv down the Dniester, LBK material is found only as imports in settlements and in the BDC environment on the territory of Ukraine, at Sinikiv, Zhvanet and Perebykivtsi (Figure 4: 29, 32–34), and of the Republic of Moldova, at Tatarauca Noua XV and Soroca V (Figure 3: 1–2). This territory was included into the BDC action sphere, which is the only explanation why the settlement of the southern zone of the area occurred through the upper reaches of the Prut.

Sites of the Carpathian-Prut interfluve

Novoselitsa in the Chernivtsi region, Ukraine (Figure 4: 31), is the base marking the direction of settling the territory of Romania and the Republic of Moldova. It is situated on the left bank of the Prut, 50–60 km from the nearest sites on the Dniester. Its position suggests different variants of population migration by water and by land. The simplest and most realistic way is rafting down the Prut, which is reflected in the sites on both banks of the river in the middle course. The other options presuppose crossing the Carpathian passes on foot and settling the north

and northwest parts of Romanian Moldova. Thus, the second way leads to the source of the Sihna and then on to the Jija (Braesti I, II, Vaslui judet) (Figure 6: 16) and is probably geographically more connected to the sites in the central zone of Moldova, which are concentrated near Iasi. The third way from Novoselitsa goes to the source of the Siret (Siret I, II and others) and may be connected with the settlement of the Pre-Carpathian zone (Figure 6: 1–15).

The distance from Novoselitsa to the sites in the Vasluj and Siret districts is almost equal, about 40 km by modern roads. However, these roads are known to have been preceded by paths that could have been and were used by LBK groups. Which of the paths were chosen in reality can only be established through typological and chronological comparisons of materials. The natural and geographical variety of the Carpato-Prut area also determines the diversity of certain settlement zones. Data of 66 sites were used for geomorphological reconstructions. They are found on all three relief layers.

Sites of the Prut basin (right bank)

They are located on the Jija, Bahlui and Barlad rivers and their tributaries, which administratively corresponds to the Botoshani, Iasi, Vaslui, Barlad and even Galat (with its most northern site Beresti) districts (Figure 6: 34). Geographically, the territory corresponds to the Moldovan lowland and the Barlad plateau. All in all, 33 sites were detected, located in the lowlands of the region (30–180 m). Only 6 of them are on elevated plots in the outlying parts of the Barlad and the Suceava plateaux, gravitating to the Pre-Carpathian zone.

Planigraphically, groups uniting 2–3 sites are located in the river valleys at a considerable distance from one another – up to 25, 40 or even 60 km. On the Jija, such groups are made up by Braesti and Vilcelen, as well as by Pogoresti, Doina and Glavaneshti Vechi (Figure 6: 18–20). On the tributaries of the Barlad (Figure 6: 16–17), groups are formed by Bareasa, Danesti and Valturesti (Figure 6: 28–30), and by Tomesti, Perieni and Podu Petris (Figure 6: 31–33). Only in the valleys of the Jija and Bahlui, near Iasi, is a different concentration marked: 14 sites are located in twos, threes and fours with a distance of only 1–3 km between them: Crevesti I, II; Leetcani I, II, Iasi I, II, Valea Lupului (Figure 6: 21–27).

Sites of the Siret basin

17 sites are located in the upper and middle courses of the Siret's right-bank tributaries, on the Siret itself, the Moldova and the Bistrita. They form small clusters with a distance of 20–30 km between them. Each consists of two, three or four sites. They are concentrated in the vicinity of the modern cities of Siret (sites of Siret I, II, Parhauti) (Figure 6: 1–3) and Suceava (Mihoveni, Suceava I, II, Baia) (Figure 6: 4–7). First, one can list the sites in the zone of salt mines and springs on the Moldova river (Oglinzi, Lunca, Tirpesti) (Figure 6: 8–10). Another group of sites lies on the Bistrita near the cities of Tirgu-Niamt and Peatra-Niamt (Jija, Tirpesti, Poiana, Negresti I, II, Traian) (Figure 6: 9–15); it is obviously connected to the passes of the Upper Suceava road. This road leads through the Bikaz pass and on to the central parts of Transylvania, the sources of the Olt and Mures. By means of the intermountain roads network, it is possible to get to the Tisza and

middle Danube area via the Prislop pass (Spinei 1985, 23). The geographical position of this region as a crossroads explains the richness of collections from the sites of Traian and Tirpești, as well as the diversity of cultural connections that they reflect (Dumitrescu and Dumitrescu 1962, 252–59; Marinescu-Bilcu 1981).

According to absolute values, the sites are all located at heights from 280 to 480 m, but predominantly from 300 to 480 m (14 sites). The Pre-Carpathian zone was settled only in its upper half, from Suceava to Piatra-Neamt (Traian) on a 140–150 km long stretch. Within these limits, the evolution of material culture can be traced from the first phases of the later stage (Traian) up to the latest, represented in Tirpești (Ursulescu 2000, 318). The situation in this case is reminiscent of the materials in Volhynia.

It is also worth mentioning that the Lower Road – the pass through the Carpathians to the Olt tributaries in Transylvania – is also marked by the presence of LBK materials near Bratei, situated on the Trotusi (Figure 6: 45).

Sites in Transylvania (the Olt and the Mures Basin)

The sites (8) are situated on the arch of the Inter-Carpathian Basin on the sources of the Olt river (Banku, Turia, Harman, Rupea) (Figure 6: 35–38) and the Mures river (Moresti, Cipau I, II) (Figure 6: 42–44). They occupy the banks of small streams and tributaries of these rivers at a height of 200–450 m. While settling Transylvania, LBK communities must have used inter-mountain roads and passes on their way from Moldova.

Orographically, the features of Transylvania correspond to the features of Pre-Carpathian Moldova. However, it should be mentioned that the natural and climatic conditions in the former are more favourable. By settling this territory, LBK groups came into direct contact with the cultures of the Vinča circle, as shown by LBK imports at the settlements of Alba Iulia, Tartaria and Turdas (Figure 6: 42–44).

In the next historical phase, the LBK communities returned to their origins, i.e. the Vinča culture, but it was a later period – Vinča B. It is worth remembering that the earliest LBK originated from Vinča A, among others. Now the same culture offered them a new modification, through a number of transformative stages, to Cucuteni-Tripolie.

Sites in Muntenia (the Danube basin)

The settlement of northeast Muntenia took place by passing the southern end of the Carpathians from the territory of Moldova through Voetin and Vadu-Soresti (Figure 6: 46–47). The sites of Suditi, Ghinoiaica, Lacu Turcului and Cosereni (Figure 6: 48–51) were located on right-bank tributaries of the Danube (the Pragova and the Ialomita), near dry Pre-Danubian steppes, which predetermined their lowland location. As well as in Transylvania, an active zone of contacts was formed here, which is represented by mutual imports and influence between the LBK, and the Dudești and Vadastra cultures (Figure 6: 52–55).

Sites of the Pruthian-Dniester region (the Republic of Moldova)

On the territory of the Prut-Dniester interfluvium there are 69 settlements which,

taking into account the geomorphological features, occupy the whole central part (Figures 2 and 3). This territory mainly corresponds to elevated relief forms, i.e. plateaux and uplands: the Lower-Cubolta Plateau, Ciuluc-Solonet Plateau, Pre-Dniester Upland and Codru Upland. Only eight sites on the Prut are located in the Middle Prut Lowland. However, the position of all settlements is bound to middle and lower relief layers with absolute heights from 40 to 180 m (predominantly to 150 m) above sea level. They are located on the descending hypsometric relief steps and in the river valleys, therefore corresponding to the definition of a 'lowland' settlement (Figure 2). They all are mostly found in valleys of medium size and along the small rivers which form the basins of the two major rivers of the Republic of Moldova – the Prut and the Dniester.

Sites of the Prut basin (left bank)

The sites located on the left bank are not numerous (8 sites – 15%). In terms of their concentration, they form a single whole with the right-bank sites of Romanian Moldova in the Iasi district. They demonstrate the same patterns, with the settlements situated predominantly along streams and rivulets: Navirnet, Moldoveanca I, II, Rezina I, II (Figure 3: 29–31, 34–35).

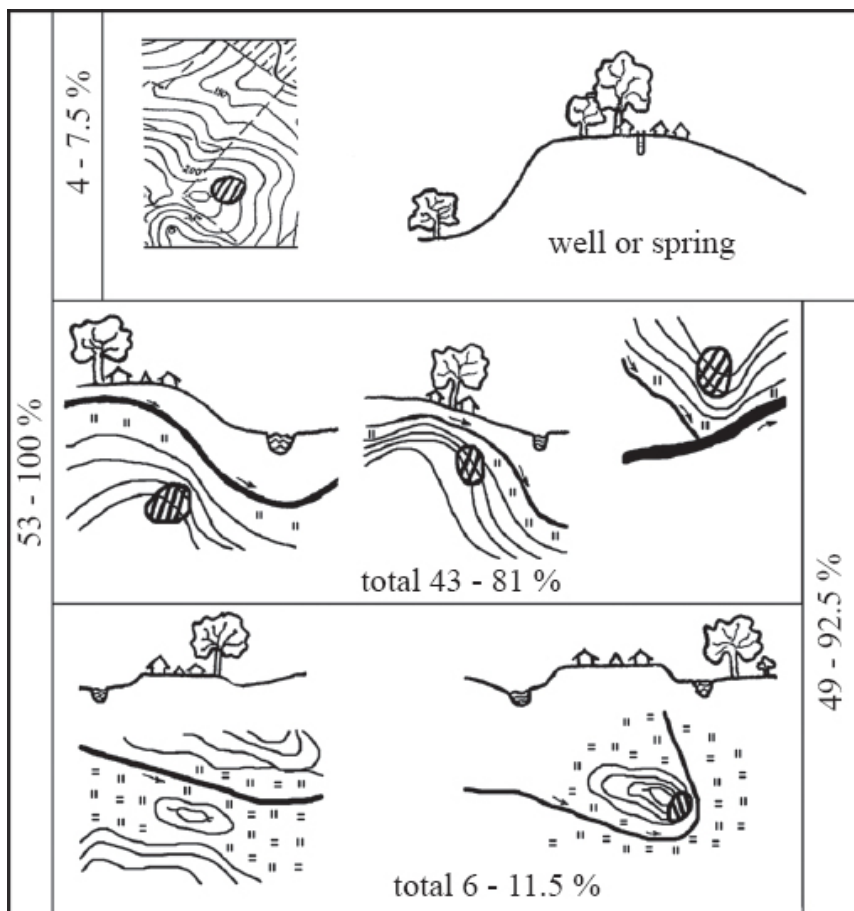


Figure 7. Sites in the Prut-Dniester interfluvial area in relation to water courses.

Sites of the Dniester Basin

These sites make up the main culture body in the interfluvial area, the most attractive zone for settlement being the Reut basin. 76% of all sites in the Prut and Dniester interfluvial area (Floresti I, II, Gura Camencii VI, VII, X, Rogojeni II, Tsira II, Singerei I, VIII, XI, XIX, Bilichenii Vechi I, XI) are located on its numerous tributaries: the Cubolta, Solonet, Great Ciuluc (together with the Middle and Small Ciuluc) and the Cula (Figure 3: 6–17). The most fertile part of Moldova – the Balti steppe – was settled.

In the southern zone, near Chisinau, the places for settlements were also chosen where water meadows were well developed and strongly pronounced, i.e. on the Bic (Panasesti I, Straseni X, XI) (Figure 3: 21–23) and its tributaries – the Isnovat (Scoreni I, Danceni I) (Figure 3: 25–26) and the Botnea (Rusestii Noi I, II) (Figure 3: 27–28).

Settlements on the Moldova river

The position of each site depends on the relief of the given region. However, the diverse settlements in the area demonstrate only a few patterns, a definite standard or ideal location (Figure 7). Most settlements (92.5%) are situated near running water. The least frequent pattern (6 sites – 11.5%) is using small upland water meadows of the rivers, rising from 0.5 m (Rusestii Noi I) to 3.5–5 m (Rusestii Noi II, Mindresti, Marculesti) above the water meadow (Figure 3: 5, 19, 28). The sites cover areas from 100x200 m to 300x500 m (Greblesti) (Figure 3: 20). However, the settlements as such occupy insignificant east or southeast ends of these uplands, being situated directly near water or less than 300 m from it.

Most often (43 sites – 81%), prominent pre-water-meadow terraces and banks of rivers, rivulets and streams were settled. About half of these settlements were arranged on the banks of rivers and rivulets. The settlers moved away from water 100–300 m or, less frequently, 300–700 m (Balti, Floresti I, II) (Figure 3: 3, 6–7) and rose 2–5 m or, less frequently, 6–20 m above the water (Straseni X, XI, Floresti 1, II, Tsira) (Figure 3: 6–7, 11, 22–23). The absolute height above sea level of the uplands ranges from 40 to 100 m, predominantly 80–100 m.

15 cases (28%) of the same pattern of settlement were recorded on the slopes of small streams at a considerable distance from major river valleys (1.5–6 km). Here, the settlements lie in the immediate proximity of stream water on heights of 50–100 m, and insignificantly rise above the valley bottom (Gura Camencii VI, VII, X; Rogojeni II) (Figure 3: 8–11). Where further away from river valleys, they are located on watershed slopes, on uplands ranging from 110–150 m, but predominantly 120–140 m in height.

About half of the settlements (20 sites out of 43) are located not merely on promontory-like ledges of terraces, but directly on the promontories formed by the confluence of two rivers or two streams (Gura Camencii VI, VII, Moldoveanca I, II) or the confluences of streams and rivulets. Here, the settlements occupy either the central part of the promontory (Coscodeni I, Floresti I) (Figure 3: 6, 18), or its edges closer to a river (Biliceni Vechi I) or to a stream (Danceni I, Radeni) (Figure 3: 6, 16, 18, 26, 32).

Further settlement characteristics

The settlements are generally oriented to receive maximum light exposure, making them well-lit and warm during daylight hours (Figure 8). In terms of soils, there is an obvious preference for chernozems, various varieties of which are found along the river valleys settled. Most often, they are typical (48.1%) and leached (20.5%), less often they are ordinary (11.6%) and carbonate (17.3%) chernozems. In the vicinity of the sites, chernozems are combined mainly with water meadow-layered and less often with meadow-chernozem soils.

The preference for certain soils also accounts for the high settlement concentration in certain microregions. Sites are placed in clusters, which is especially clear on the Great and Middle Ciuluc, as well as on the Reut (Balti steppe). Thus, there are eight settlements along 14 km of the middle course of the Middle Ciuluc, i.e. each site's catchment comprises less than 2 km of water meadow. The actual distance between sites ranges from 0.2 to 1.5 km. A similar picture can be observed near Floresti, where 7 settlements are situated on 18 km

of the Reut. It should be pointed out that a similar situation was revealed by G.V. Ohrimenko for settlements on the Chornoguzka in Volhynia. On the territory of Romania such concentrations are found on the Jija and Bahlui.

Conclusion and further research

The emergence and spread of the LBK-type tradition of the early Neolithic east of the Carpathians corresponds to the general European tendencies of the culture's development. The conditions of a dry and warm climate at the turn of the Atlantic-1 – Atlantic-2 periods contributed to the appearance of earliest LBK groups east of the 24th parallel on the territory of Volhynia: Gradek Nadbujanskiy and Rovno. As veritable outposts, these two sites, lying 160 km apart, marked the boundary of the chernozem soils of the Volhynia Upland. The further development of the LBK culture in Volhynia took place within these limits. Extremely well represented are the early stages of the late LBK (Zoziv I and II near Rovno (Figure 4: 14–15); Golishev, Girka Polonka near Lutsk (Figure 4: 6, 8)). Their establishment continued the process of looking for the southern territories most suitable for settlement. It was complemented by a second wave of population migration from southeast Poland, from the San source to the Dniester source (Kotovane).

The same principle of first establishing outposts was true for the early stage of settlement in the southern periphery, where they marked out boundaries and indicated the direction of further migration. On the basis of their material culture, the sites of Markovtsi near Ivano-Frankivsk (Figure 2: 20), Traian in the Pre-Carpathians and Larga Jija in the Prut basin (Romania) were attributed to the first phase of the later LBK. Therefore, by that time routeways had been reconnoitred and led to the most suitable settlement zones far to the south of the initial centre of the culture's formation. For this time, one can also recognise connections with more remote territories occupied by other cultures. The Markivtsi materials proved a distinct and strong connection with the traditions of the Hungarian Alföld. This contact was also confirmed by the arrival in the area of obsidian mined near the source of the Tisza. These imports continued throughout the whole course of the LBK's evolution.

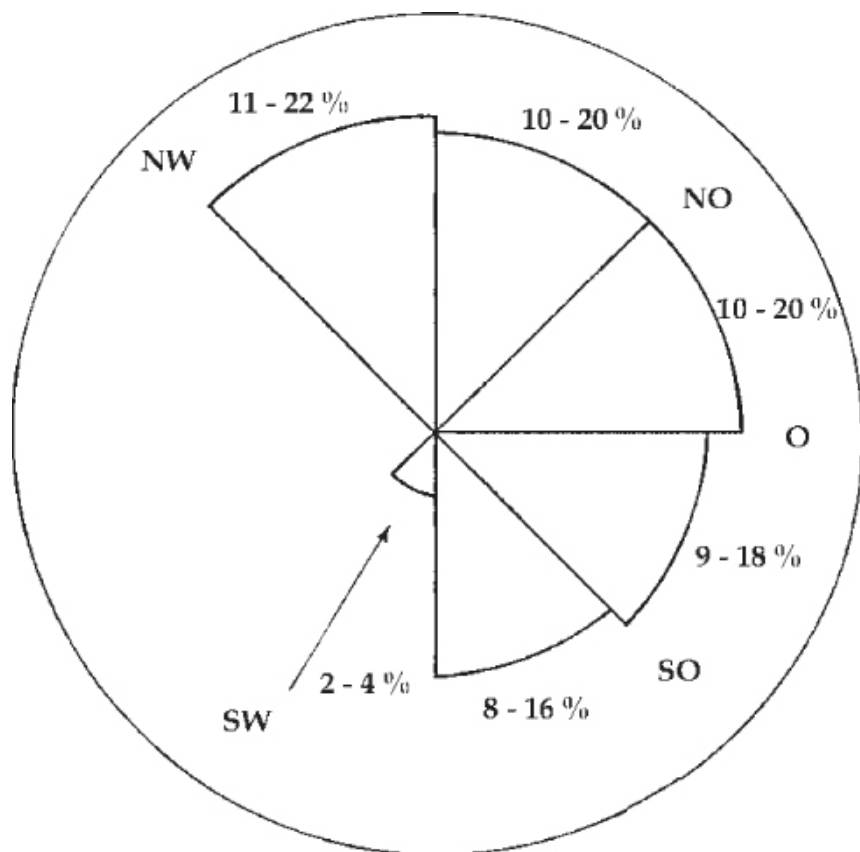


Figure 8. Exposition of sites in the Prut-Dniester area.

Large-scale settlement of the territory took place in the following stages (II-III) of the developed 'classical' musical note ceramics. By that time, the culture's boundaries were also established in the southern zone of the area. The most intensive process was the settling of right-bank tributaries of the Prut – Jija and Bahlui in the Carpathian-Prut region. In the Prut-Dniester interfluvium, it was the zone of the Reut basin. Each of these concentrations can also be viewed as a relatively closed system within the limits of which a material evolution from earlier to later took place.

The final stage is represented by the most numerous sites in the whole area: Gnidava in Volhynia; Nezvisko, Torskoe on the Dniester; Tirpesti and Traian in Romania; Floresti I, Gura Camencii VI, Tsira II in the Republic of Moldova. The dominant trend of this stage was the emergence and increase in the LBK repertoire of Jeliz group elements, as reflected in the transformation of pottery design as a whole. For the southern zone of the area, a modification of decoration technique from the drawn band type to a cannellure-like type was also traced. It was a process of evolutionary change in the culture's affiliations. Through a number of stages and through interactions with the southwestern cultures of Dudești, Vinča B

and Boian, it led to the rise of Pre-Cucuteni Culture I. The most significant element in this process is the continuation and perfection of the farming economy, while the role of hunting and gathering was subordinate.

At present, for the eastern boundary of the extreme east periphery there are multiple examples of LBK materials present on sites of other cultures, as well as evidence for its influence on the process of Neolithisation in northern, eastern and southeastern regions of Europe. In the eastern periphery of the area, they are spread in a fan-like manner from the West Dvina to the Danube and further to Asia Minor (Figure 1).

The settlement of Dubokraj V, mentioned above, is in the opinion of A.M. Miklyaev the most northeasterly analogue of the central European LBK. According to this scholar, the originality of these materials allows to classify them as a separate culture, but still an LBK variant. It must have originated from a combination of the local technological tradition of the Sertei culture with an ornamentation of Köln-Lindenthal type (Miklyaev 1995, 14, 18, fig. 3). Judging by the set of vessel forms, represented by bowl-shaped containers and closed bowls, I think that an initial impulse could contain elements of the earliest LBK stage.

As early as the first phase of the later LBK, materials from the Volhynia territory move in an easterly direction and are distributed up to the Dnieper, to the Dnieper-Donets culture. The finds in Zhitomir Polesye (Fasovaya) and Kyiv (Vita Poshtova 2) (Figure 1) are examples (Telegin 1979, 232–33; Gaskevich 1998, 11–13). In its middle and late phases, the LBK is most active in mutual contacts with the Bug-Dniester culture. LBK artefacts are found along the whole length of the cultures' contact zone on the Dniester and up to the South Bug: Bazkov island, Soroca V, Mainova Balka, Tatarauca Noua XV (Figures 1; 4: 32–35; 3: 1–2) (Danilenko 1969; Markevich 1974; Dvoryaninov 1982; Larina 2006).

Besides, there is a marked spread of LBK material in southeastern and southern directions during the latest phases. Thus, LBK and Boian ceramics are found together on the tell-like site of Orlovka II (Reni district, Odessa region, Ukraine), located in the floodplain of the Danube delta (Figure 1; 3: 38). Moreover, late LBK materials with Jeliz elements reach the borders of Asia Minor, where they are found on the Bosphorus in the third layer of Tell Yarimburgaz in the European part of Turkey (Figure 1) (Özdoğan *et al.* 1991, fig. 3).

The distribution of material at the end of the LBK's existence could have been predetermined by the natural and climatic features of this period. By the mid-end of the 5th millennium B.C., a significant cooling and aridisation of the climate is attested in the Ukrainian plain, which could result in major cultural upheaval in a broader area (Bezusico and Kotova 1997, 146). However, by this time the rise of new, Eneolithic cultures had already begun.

Notes

1.e. leached soil formed in cool, humid conditions.

2.e. meadows consisting of broad-leaf herbs rather than grass.

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Settlement history of the Linear Band Pottery culture in Kuyavia

Joanna Pyzel

Introduction

Kuyavia is a region in central Poland, on the left bank of the Vistula river (Figure 1). It constitutes a part of the Polish Lowland, which as such does not belong to the most typical Linear Band Pottery culture (LBK) landscapes. In Kuyavia there are no loess soils, which are regarded as an important factor that attracted LBK settlement. Gleysoils prevail there instead, which are in fact as fertile as chernozem (Pyzel in press). The particularity of this region lies not only in its soil, but also in the natural strategic location and this is one of the reasons that Kuyavia is archaeologically one of the most interesting and one of the best studied regions in Poland (Cofta-Broniewska and Koško 2002).

However, Kuyavia is not only interesting for the study of the Polish LBK. This region on the northern edge of the 'Danubian' world, where some centuries later a very specific lowland Neolithic (TRB) emerges, awakens interest among many, and not only Polish, Neolithic specialists. Unfortunately the state of excavation does not reflect this interest, although the tradition of LBK research in Kuyavia is long – the first sites were discovered before the First World War. Nevertheless the current state of research cannot be regarded as sufficient (Pyzel 2005). There is especially a lack of large-scale excavations, which would enable discussion about settlement size and organisation.

This explains why remarkable opinions about the different – less stable – character of the LBK on the Lowland in comparison to the loess areas could have persisted in the archaeological literature for so long (e.g. Wiślański 1970; Bogucki 1979; 1988; Gurtowski and Kirkowski 1994; Grygiel 2004).

This interpretation originates from the tradition of looking at archaeological cultures in terms of creative centres opposed to much more passive provinces (e.g. Soudský 1954). In such a scheme, Kuyavia is the region far, far away from the source and centre of the LBK and this location must have had an impact on the cultural development here. Regarding the speed of the spread of the LBK, it was believed that Kuyavia should have been colonised much later than other regions (Wiślański 1970; Bogucki 1979; 1988). The recent discovery of an early LBK assemblage, dating to the Polish phase I (*älteste* and *ältere* LBK; Czerniak 1990) challenged these opinions (Bogucki 2000).

It is astonishing that in the Polish literature about the LBK, one does not find the same kind of discussion on the origins of the LBK (*'Bandkeramisierung'*) which is prevalent in other European countries (e.g. Tillmann 1993; 1994; Kind 1998; Scharl 2004; Lüning 2005; in press; Kienlin 2006; Price *et al.* 2001; Zvelebil 2004). Instead there is agreement among the Polish scholars, who state that the beginning of the Neolithic in Kuyavia must have been the result of a migration or migrations connected with the LBK. It is said that there were many different regions of origin, not only Lesser Poland in the southeast and Silesia in southwest Poland, but also on the other side of the Carpathian Mountains, in Slovakia or Hungary (Kulczycka-Leciejewiczowa 1979; Czerniak 1988; 1994; 1996; Grygiel 2004). In Czerniak's opinion (1988, 67; 1994, 19), different migration movements continued throughout the LBK period. As a result, the carrying capacity of the region would have been reached and thus forced the Kuyavian population to look for other, new habitats on the Lowland.

Grygiel (2004, 644) instead postulated a completely different scenario: he states that LBK settlement in Kuyavia was definitely less intensive than in the loess areas, and thus the LBK population was so small that it left Kuyavia at the end of the LBK and migrated to the area of the Elster-Saale basin in central Germany. These two opposing interpretations do not only refer to the LBK, but also to the origin of the succeeding post-LBK cultures.

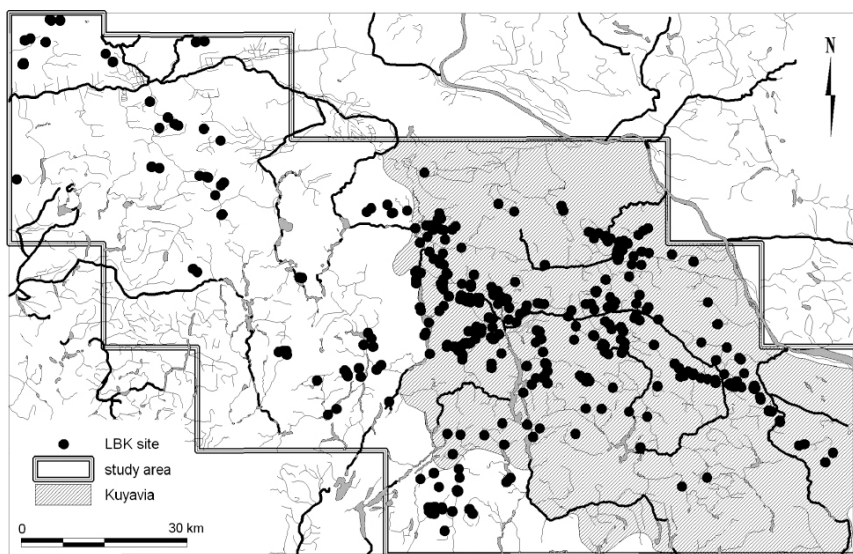


Figure 1. LBK sites in Kuyavia, Paluki and eastern Great Poland and the boundaries of the study area.

This brief overview shows the most controversial topics of LBK research in Kuyavia: the origins and process of Neolithic colonisation, and the character and scale of LBK settlement and its decline. These topics seem essential not only on the Kuyavian, regional level of research on the LBK, but are of interest to the whole 'Danubian' Neolithic.

Although it is not always an easily resolved discussion, I addressed these topics in my Ph.D. thesis on the LBK in Kuyavia (Pyzel 2006a).

One of the main aims of my research was to try to reconstruct the settlement history of the LBK in the study area. Within the Kuyavian LBK, I wanted to trace changes and processes in time and space and avoid treating this culture as monolithic, which is usually the case in cross-cultural settlement studies (cf. Kruk 1980). For this purpose, I first needed to establish the relative chronology of the LBK in Kuyavia to date individual sites. In this paper, I would like to present my main conclusions.

Study area and state of research

My study area (Figure 1) includes not only Kuyavia (4,616 km²), but also its neighbouring regions to the west, Pałuki and northwestern Great Poland (9,124.4 km² altogether). The boundary was chosen with the aim to compare different lowland landscapes (cf. soil preferences; Pyzel in press). In total, 94% of my study area was surveyed; of these, Kuyavia itself can be regarded as the best surveyed.

A total of 386 LBK sites were identified in the area (Figure 1). I had a good opportunity to assess the reliability of this number due to the routes of pipelines and motorways laid in linear transects across Kuyavia and which required rescue excavations (Pyzel 2006b, fig. 23; in press, fig. 1). The settlement map of the LBK does not display considerable differences irrespective of whether the sites encountered in the course of these construction projects are included. It is worth mentioning that alongside densely inhabited areas, there are also uninhabited ones. Some of them can be explained by unsuitable environmental conditions (soils, water), but in some cases other explanations of this specific settlement distribution need to be sought. Settlement concentrations and settlement gaps become visible when applying the isoline method. An isoline is a contour line indicating equal density of sites in a landscape. The isoline method can be used to illustrate a concentration of settlement with a contour map consisting of a sequence of consecutive isolines. From all these isolines an 'optimal' one can be statistically chosen and used to define boundaries within a densely inhabited settlement area (Zimmermann *et al.* 2004). For the Kuyavian LBK such an optimal isoline is the 3.5 km line (Pyzel 2006b, fig. 20; in press, fig. 1), which encompassed one large settlement area in Kuyavia and some smaller ones in neighbouring regions. If a lower value than 3.5 km is chosen, this one large area splits into several smaller subregions, enabling study of the internal settlement composition of Kuyavia. For these reasons, I adopted the 2.5 km isoline for settlement studies (Figure 2).

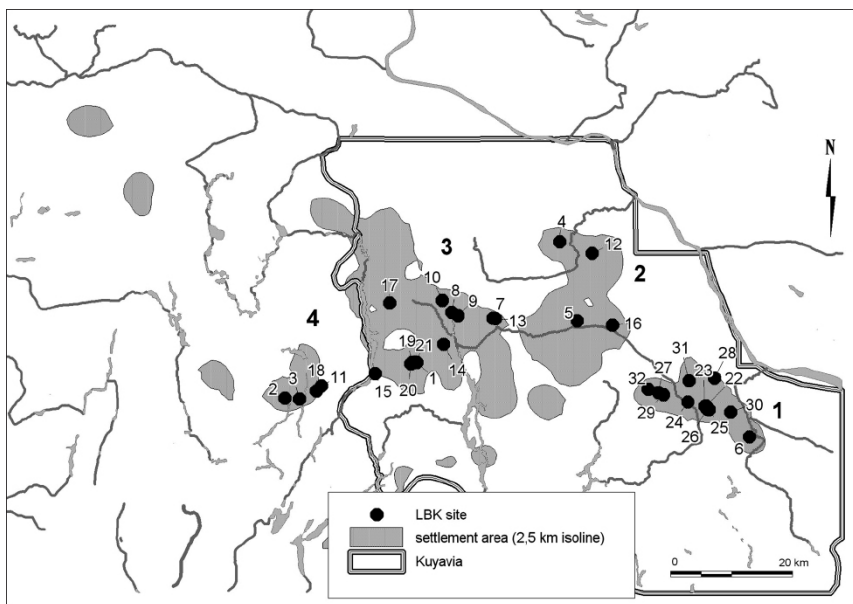


Figure 2. 32 dated LBK sites and 2.5 km isoline (no. 22–32: sites analyzed and published in Grygiel 2004) 1. Bożejewice 22/23; 2. Chabsko 24; 3. Chabsko 40; 4. Grabie 4; 5. Kuczkowo 5; 6. Ludwinowo 7; 7. Łąkocin 1; 8. Łojewo 1; 9. Łojewo 35; 10. Miechowice 7; 11. Olsza 9; 12. Przybranowo 3; 13. Radojewice 29; 14. Rożniaty 2; 15. Rzadkwin 22; 16. Siniarzewo 1; 17. Węgierce 1; 18. Żabienko 12; 19. Żegotki 2; 20. Żegotki 3; 21. Żegotki 18; 22. Brześć Kujawski 3; 23. Brześć Kujawski 4; 24. Falborz 1; 25. Guźlin 1; 26. Guźlin 2; 27. Konary 1; 28. Machnacz 1; 29. Miechowice 4; 30. Smólsk 2; 31. Wolica Nowa 1; 32. Zagajewice 1.

Almost 23% of the 386 LBK sites in the study area were excavated. Most of them were old, small-scale excavations. The largest excavations took place on the LBK site of Ludwinowo 7, situated on the planned A1 motorway route, where an area of 4400m² with 195 LBK features has been revealed so far (Pyzel 2005). This site was chosen alongside 20 others as a random sample (5.4 % of the whole site number) to analyse the pottery, study the relative chronology of the Kuyavian LBK and ultimately to model the settlement history of the region. The sites lie in different parts of Kuyavia (four areas of the 2.5 km isoline, Figure 2, sites 1–21) and represent all chronological stages of the Kuyavian LBK. Although most of the sites were previously studied and partially published (Czerniak 1988; 1990; 1994; Czerniak and Pyzel in prep.; Fredrych 1982; Nadolna 2001; Mrowiec 1998; Pyzel 1999; 2005), I re-analysed the ornamented pottery from them, applying a new approach as a starting point for a relative chronological sequence.

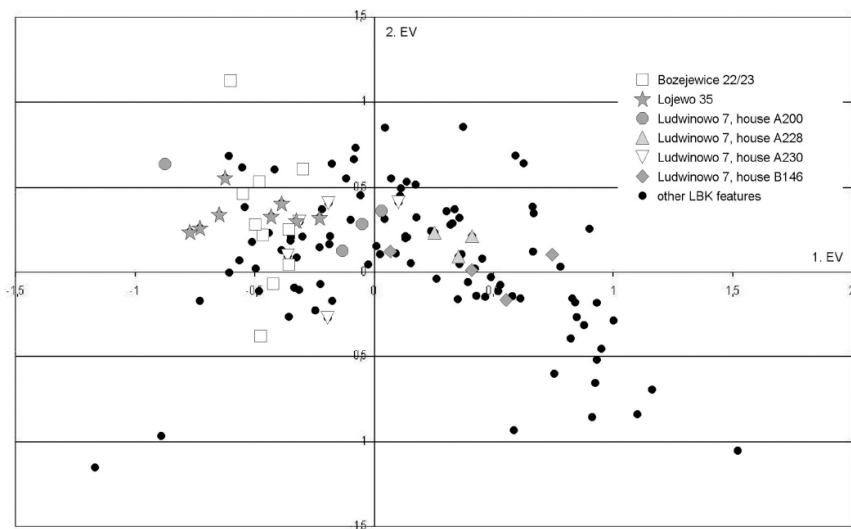


Figure 3. Correspondence analysis of the LBK features belonging to 6 households in Kuyavia.

Pottery analysis and the study of relative chronology

Altogether, I recorded 10,844 pieces of decorated pottery from 128 features, choosing those which could be regarded as to some extent homogenous and contemporaneous assemblages. For the objectives of my study, I found that the most appropriate tools for analysing pottery were developed in the German research tradition, in the course of the “Settlement History of the Neolithic of the Aldenhovener Platte” (SAP) research project in the Rhineland (Stehli 1973; 1988; 1994; Kerig 2005).

As a first step, I analysed many technological (temper, wall thickness) and stylistic features (Pyzel 2006a). The most informative and distinctive features for addressing chronological questions were the main ornaments of the vessels, which can be described as a band, the so-called *Bandtypen* (Pyzel 2006a; 2006b). In the western LBK there is a long tradition of this kind of classification, but the Kuyavian LBK pottery ornaments are very different; therefore, it was necessary to define new types more suitable for these ceramics. As a statistical tool I used correspondence analysis, which is a statistical visualisation method for picturing the associations between two traits; in this case of 229 *Bandtypen* and 128 LBK pits. The results can be presented as a plot with separate sets of points for each trait. The distances between the points are measures of similarities, which in the case of the pits can be interpreted as a chronological similarity.

I tested this hypothesis through an example of contemporary pits belonging to one household. In my study, only six well defined households have been discovered so far. These household pits constitute distinct clusters on the correspondence analysis plot (Figure 3), regardless of their chronology or location within Kuyavia. From this, one can conclude that the length of an LBK household's life cycle was relatively stable. This raises hopes that in the future it will be

possible to apply the concept of house generations (*Hausgeneration*) in Kuyavia, as has been achieved on the Aldenhovener Platte in Germany, where they are the smallest chronological entity (Stehli 1988; 1994). Here, a fine-grained relative dating framework allows to subdivide the entire LBK pottery sequence into chunks of roughly 25 years length, to which individual houses can then be assigned. On this basis, changing settlement dimensions and layout can be recognised (see also Claßen, this volume). At the moment there are too few households in Kuyavia for the model to be successfully applied, so the common periodisation divides the Polish LBK into only three phases: I – early (*älteste*), II – middle (music note), III – late (for Kuyavia: Czerniak 1994; Grygiel 2004). In a recent publication, Czerniak (2004) proposed the division of phase II into two subphases: IIA – early music note, IIB – classic music note. The results of my research go beyond current phase definitions and specify not only their characteristics (Pyzel 2006a; 2006b), but also their length, which is important in comparing different settlement processes. On the correspondence analysis plot, I marked the LBK pits with already established relative dating. I then allocated the other pits to chronological units through an analysis of the point distances (Figure 4).

Settlement history of the LBK in Kuyavia

For constructing models of the settlement history in Kuyavia, I also used the results from Grygiel's (2004) recent publication of 38 features from 11 sites near Brześć Kujawski and Osłonki. Including them, I had a total of 32 dated sites (8.3%; Figure 2). On a settlement level, the following conclusions about the settlement history of the LBK in Kuyavia can be drawn (Figure 5):

The first phase is represented on only two sites and in both cases their dating is controversial. For Grabie 4, typologically younger traits can be distinguished alongside many old stylistic elements. The excavator proposed two different interpretations; in the first, the whole assemblage is regarded as heterogeneous (Czerniak 1990), and in the second as homogeneous, but with archaic traits (Czerniak 1994). The pottery assemblage from Wolica Nowa is very small. For this reason, one can state that LBK settlement of the first phase was undoubtedly present in Kuyavia, but only to a small extent. It is not possible to define the length of this period.

The later phases are already much better represented. 14 of the 32 sites are dated to phase IIA (43.75%), 15 to IIB (46.88%) and 19 to phase III (59.38%). It is important to point out that on many sites, some occupational phases spanned more than one LBK phase. 19 of the 32 sites yielded finds from only one LBK phase, but this could have been influenced by the small-scale nature of the excavations; in ten cases only a single pit was discovered. If these sites are excluded, nine of the remaining 22 sites are settled in a single phase (40.9%), eight are settled in two (36.4%) and five are occupied in three phases (22.7%). If we consider the state of research and the scale of excavations mentioned above, the relatively high number of settlements lasting three phases indicates that the occupation of many of the LBK settlements in Kuyavia was more durable and stable than previously suggested.

Local continuity and development are also visible on the correspondence analysis plot (Figure 4). The boundaries between the relative chronological phases

are fuzzy, there are long periods of overlap when pottery typical for an old and a new phase coexist. This coexistence can be interpreted as evidence of a gradual, local development of the Kuyavian pottery styles. Any of the new phases (IIB, III) could have been caused by intense new influences from other regions.

Another trend identified from the correspondence analysis plot (Figure 4) is crucial for the reconstruction of LBK settlement history in Kuyavia: phases IIA and IIB together last as long as phase III. I want to propose the following general absolute dating of these phases, based on a few ^{14}C -dates (see Grygiel 2004, 633, table LIII) and the relative chronology I developed, although the fuzzy boundaries mentioned above must be taken into account here:

Phase IIA c. 5300/5250–5200 cal BC

Phase IIB c. 5200–5100/5000 cal BC

Phase III c. 5100/5000–4900/4800 cal BC

If we consider this chronology in our reconstructions of a settlement history, it becomes clear that the high number of settlements in phase III is misleading. Actually, settlement could have diminished at the end of the LBK and certainly did not increase in comparison to phases IIA and IIB. It is interesting that the number of sites had remained relatively stable from phase IIA. Their geographical distribution is remarkable as well (Figure 5). In phase IIA, all small settlement areas encompassed by the isoline 2.5 km in Kuyavia were already settled. In the next phase, the first settlement appeared in area number 4, outside Kuyavia, which had its real settlement boom in the latest phase. At the same time, the number of settlements in the neighbouring area 3, within Kuyavia, seems to have diminished.

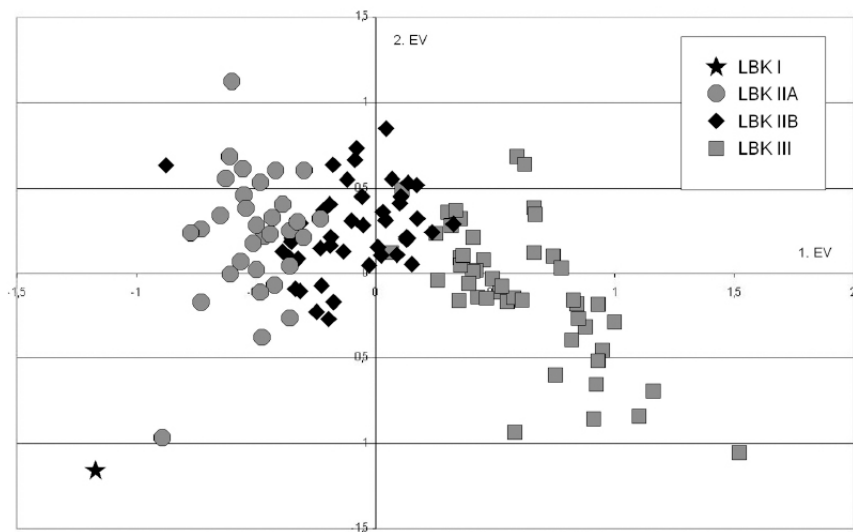


Figure 4. Correspondence analysis of the LBK features with their relative dating.

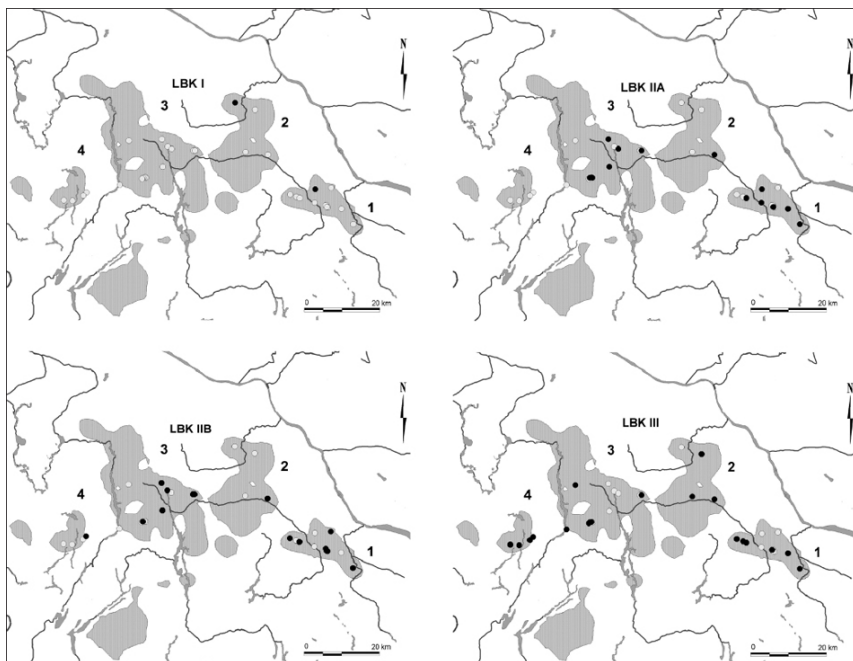


Figure 5. LBK settlement in phases I–III (black dots = sites settled in each phase).

Discussion

Results obtained for the test of 8.3% of sites stimulate reconstructions of the settlement history of the LBK in Kuyavia and on the Lowland, although many questions still remain irresolvable. It is beyond dispute that the farming colonisation of Kuyavia (and the neighbouring Culmerland – Kirkowski 1994) started in the early LBK (LBK I), at the time of an intensive expansion of this culture across Europe. It needs to be emphasised that from this time onwards Kuyavia belongs to the LBK world, although the LBK community in this phase was still small here. Intensive settlement, covering the entire Kuyavian region, starts in the 53rd century cal BC. In many regions of the LBK, it is a period of intense, dynamic changes (Lüning 2005; in press). It is difficult to say what the causes and mechanisms of the rapid and massive population growth were. What was the role of the indigenous Mesolithic populations and were new Neolithic colonists involved in this process? Analysis of LBK finds do not help to determine precisely where the Neolithic colonists came from and how they were related to the LBK inhabitants of phase I: is it a local development or is it caused by outside influences? Later development is clearer, as in the course of phase IIA the growth of the Kuyavian population levels off and it develops further at its own rhythm.

The question remains: why is the demographic expansion, established for the beginning of phase IIA, not visible later? Does it merely reflect a change in settlement size and organisation, or does it mean that population growth ceased? The current state of research does not allow any firm conclusions. We do not know

whether expansion really ceases or rather finds new areas outside Kuyavia. It is interesting that settlement outside Kuyavia, in the western neighbouring regions, seems to date slightly later. The reasons of the change in direction of the potential migration and farreaching mutual contacts are unclear. It is interesting in this context that the previously important cultural connections to the south, which can be traced with the aid of pottery, are gradually replaced by the new western connections.

It is too easy to argue that the Kuyavian populations reached the environmental carrying capacity, which forced them to look for new land to settle and finally led to a crisis and the end of the LBK world. The lack of evidence for population growth during the later development of the LBK in Kuyavia seems to challenge this hypothesis. Furthermore, the settlement gaps attractive to Neolithic farming remain free of settlement until the end of the LBK. Latest estimates of the population density during the LBK in central Europe provide arguments against a cultural crisis caused by overpopulation (Zimmermann *et al.* 2004). On the other hand, the results I obtained do not support the opposite hypothesis that LBK settlement in the study area was so small-scale and unstable that it was not difficult for the Kuyavian population to migrate and settle elsewhere without contributing to the further development of the Neolithic in Kuyavia. There is no evidence that the LBK settlement in Kuyavia was less stable than in the other settlement regions of this culture, both in terms of number of sites and duration of their occupation. Unfortunately it is not possible to study the slight changes in settlement processes through time within the LBK, but one cannot exclude that there could have been times of less stable settlement or even some population movements. The end of the LBK still remains a mystery but, nevertheless, the similarity in settlement patterns and remarkable continuity between the LBK and post-LBK cultures in Kuyavia is obvious (Czerniak 1998; Midgley 2005; Pyzel in press).

In sum, it was the LBK that began the Neolithisation of Kuyavia and this process had direct and farreaching implications for the further development of this region. The results I obtained show that Kuyavia was not an aberrant outlier of the LBK world but a quite ordinary settlement enclave. Of course, many important questions are still left unanswered: who were the inhabitants of Kuyavia? Did they feel like a single 'Kuyavian group'? If this group existed at all, what were its boundaries: did it encompass only Kuyavia or the whole Polish Lowland? To answer these and other questions, further studies in Kuyavia and its neighbouring LBK settlement areas are necessary.

Acknowledgements

Research was carried out at the Polish Academy of Sciences under Prof. L. Czerniak. I conducted most of my research at the University of Cologne, Germany, thanks to a kindly scholarship support from the *Deutscher Akademischer Austauschdienst* and the *Römisch-Germanisches Zentralmuseum* in Mainz.

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The exchange of LBK adze blades in central Europe: an example for economic investigations in archaeology

Britta Ramminger

The term 'Economic Archaeology' is still more or less uncommon in German-speaking scientific research, although aspects like production and distribution have a long history of investigation in prehistoric archaeology. Nowadays, these aspects have become more important, in particular through the intensified use of methods from the natural sciences. Mineralogical and geochemical investigations of different materials such as stone, ceramic or metal help us to identify raw material sources, manufacture and distribution sites, as well as to formulate theories about exchange systems. In economic archaeological investigations, goods can be regarded as an equivalent of the direct needs of prehistoric people, and as a consequence as an expression of social status, identity or sacred acts (Zimmermann 2001). Therefore, analysis of economic activity is not merely limited to the material level of goods, but rather considers the socio-cultural integration of the appropriate objects in the wider understanding people had of their world. In terms of economic archaeology, supply mechanisms, use rights, technological possibilities and the division of labour are of the same importance as social conditions, value systems and communication routes. For that reason, economic investigations of archaeological artefacts cannot be separated completely from other aspects of archaeological research, for instance settlement and landscape archaeology, although they represent their own branch of study.

Based on the example of LBK adze blades, some aspects of economic archaeological investigations will be presented here. Adze blades are one of the characteristic artefacts in LBK inventories. They are regular finds in settlement pits and in many regions grave goods for men, occurring in women's graves only exceptionally. In addition, there are deposits containing blanks and semi-finished products alongside finished artefacts (Vencl 1975; Jeunesse 1998). By investigating use-wear and through archaeological experiments and ethnographic analogies we know that they were used for different kinds of woodworking. Anthropological investigations of the victims of the Talheim massacre or of the skeletons from Asparn a.d. Zaya show that adzes were occasionally used as weapons (Wahl and König 1987; Teschler-Nicola *et al.* 1996).

The raw materials of these portable tools frequently arrived at the places of their

final deposition from a long distance. It is for that reason that we must imagine a far-reaching exchange network, in which adze blades were also considered prestige objects. In order to reconstruct the potential value of a certain adze type or raw material in early Neolithic society, it is essential to record the artefacts in their different contexts, such as production, distribution and use. Materials imported from a longer distance can be assumed to have been especially appreciated by the Neolithic population, since these rocks were not available directly and at any time. Appreciation could also have been connected with the acquisition, the function or the production of the adzes. In addition, the carefulness of workmanship, which can be understood as aesthetic expression, and the size of the blade can also be seen as an indicator of value. Beside this, adzes might have played a major role as means of expressing group affiliation, as mementos of certain associated acts, places or persons, as well as by their possible integration in myth and religion in the early Neolithic life-world.

One possibility of examining distribution patterns is to observe the degree of exploitation to reveal the logistics of provision. The majority of adze blades originate from settlement waste pits and accordingly they are often strongly fragmented (Figure 1). Interestingly more detailed studies show different reworking traces on many artefacts, which suggest long, persistent use and recycling. Such reworking traces range from individual re-sharpened parts, to those modified several times and up to secondarily adjusted fragments, from which completely new forms result. As a last stage of use, we find scrapers and arrowheads made from recycled adze fragments, alongside adzes secondarily used as hammerstones (Figure 2).

For the investigation of demand and supply, the total number of adzes per house and site is of importance, as well as the percentages of different raw materials in the settlement and grave inventories. For example, from north Hesse, one of our key study regions, several adze-rich LBK sites are known, which in each case yield over one hundred or even over two hundred pieces. In comparison, in the loess-rich Wetterau in central Hesse the highest number per site is 72. Even the long-settled central place of Nieder-Mörlen with more than 100 houses did not provide quantities as large as some of the north Hessian sites (Figure 3). In northern as well as central Hesse, the majority of artefacts originate from surface collections. Differences reflecting specific interests or abilities of the collectors can be excluded as a cause for the substantially larger quantities in north Hessian inventories, because in central Hesse surveys have a long tradition and many small fragments are also present. Both the intensity of the surveys and the existing find spectrum suggest a higher than average ratio for this location. There must therefore have been reasons for the occurrence of different quantities in Neolithic times. One reason could be a better supply of adzes in northern Hesse as a result of local production with indigenous raw materials. In this case, we would expect a high percentage of local raw materials such as basalt and a higher proportion of industrial waste, blanks and semi-finished products. In the case of functional differences between north and central Hessian LBK sites, we should, therefore, find different adze types as well.

Typology

The variability of functional classes is not particularly great in the polished industry in comparison with that of the chipped industry. According to a metric typology based on the height/width index and the absolute width, one can distinguish slim high adzes from broad flat examples. In addition, and between these two groups, another form called medium-high adze is classified. So-called miniature adzes appear as the fourth group (Figure 4).



Figure 1. Adze fragments.

1 Small adzes, a maximum of 2 cm wide and 2.2 cm high. The height/width *100

index is more than 70.

2.Flat adzes with height/width *100 index under 50. Most of them are wider than 3 cm and lower than 2.5 cm.

3.Medium-high adzes with height/width*100 index between 50 and 100 and absolute widths between 2 and 6 cm. Most of them are 3 to 4 cm wide.

4.High adzes with height/width*100 index over 100 and absolute widths between 2 and 4 cm.

These different types are not so much relevant in chronological terms; rather they represent diverse tools which were used for different purposes. Within the Hessian assemblage, most of the adze blades come from settlement inventories. Correspondingly, the majority of the existing artefacts are more or less strongly fragmented. For this reason, the types were compared to those from central European grave inventories. The comparison shows a remarkable similarity of the metric data and proportions in grave and settlement inventories (Figure 5). From this, we can postulate a high degree of standardisation in primary tool production. In all contexts, all four types are represented. It is remarkable that both settlement areas show nearly the same percentages of adze types, whereas in graves the proportion of high adzes is conspicuously higher (Figure 6). Only the percentage of small adzes is similar in every context. The functional differences reflected in the distribution of adze types between the two regions of northern and central Hesse are unverifiable. The lack of medium-high and high adze blades in settlement inventories can be connected with a use of high blades for clearing outside the settlements, whereas small and flat adzes were used for woodworking within the settlements.

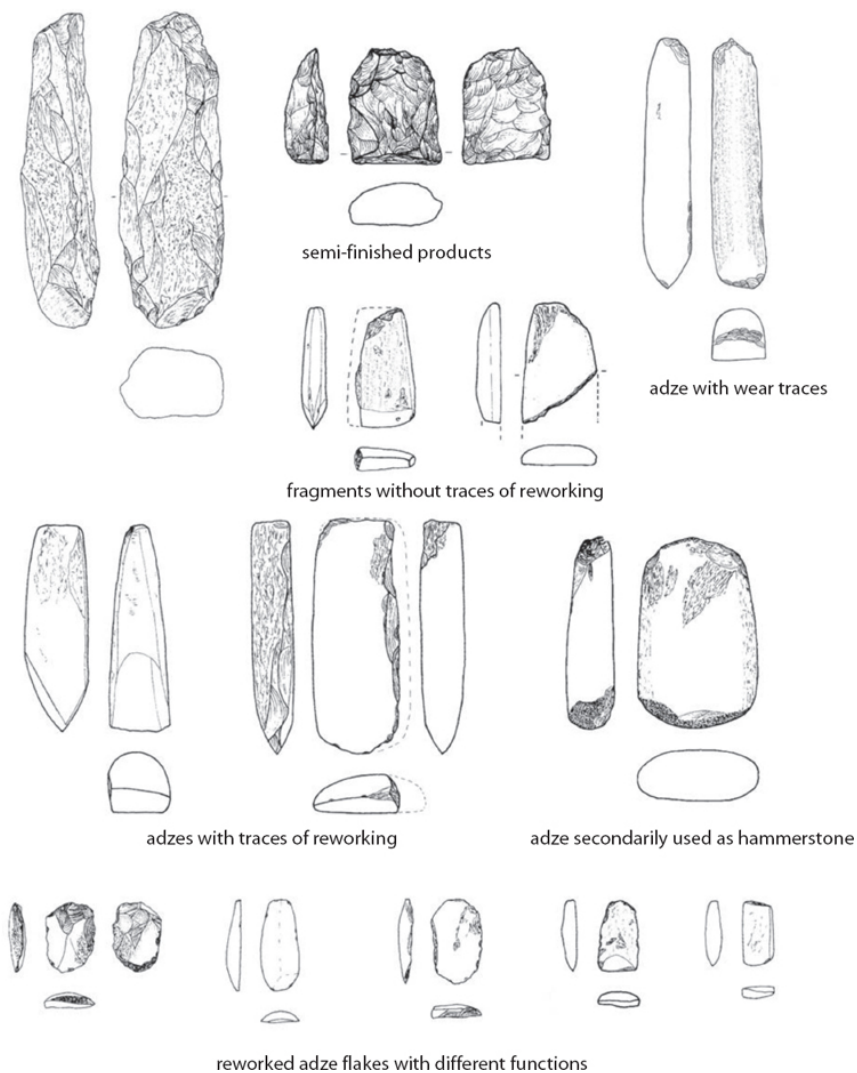


Figure 2. Production and reworking stages of adze blades.

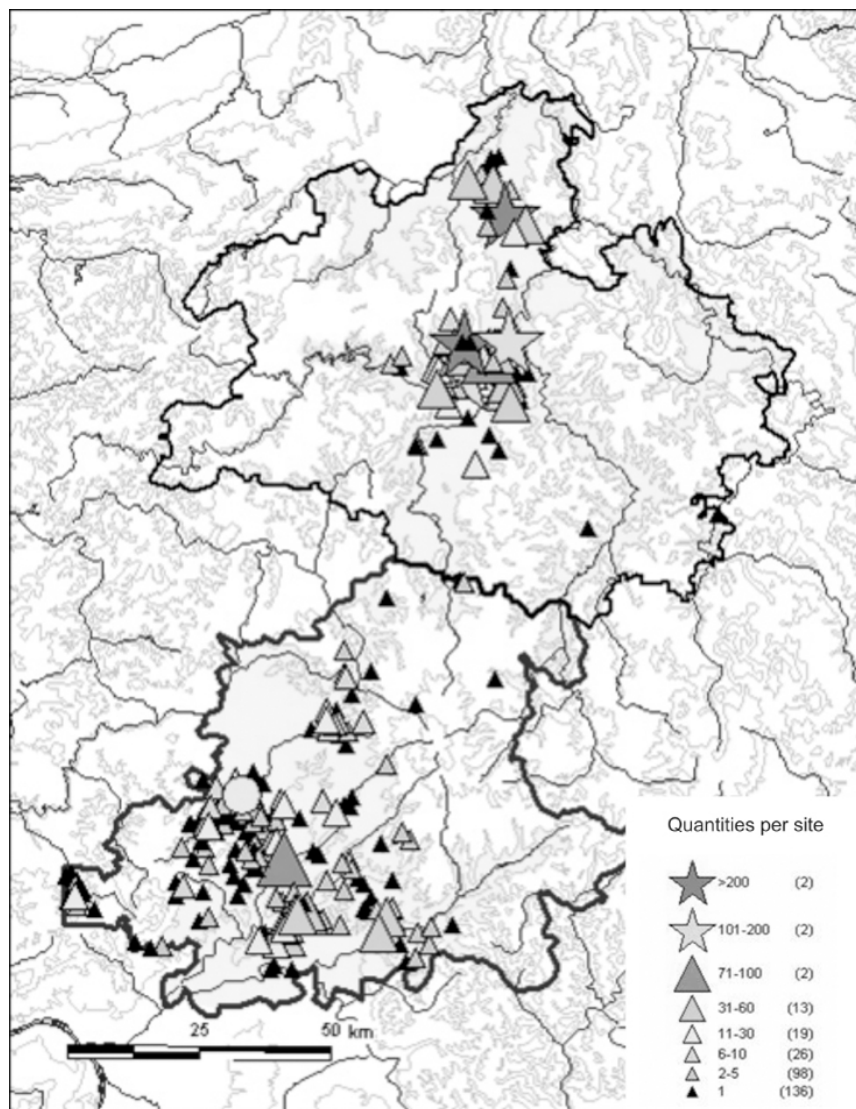


Figure 3. Number of adze blades on LBK sites in central and northern Hesse.

Raw materials

In central as well as in northern Hesse, only few rocks were used for the production of adze blades. In each case, metamorphic rocks of the group of amphibolites dominate. In all examined micro-regions they represent more than 50% of the existing raw materials (Figure 7).

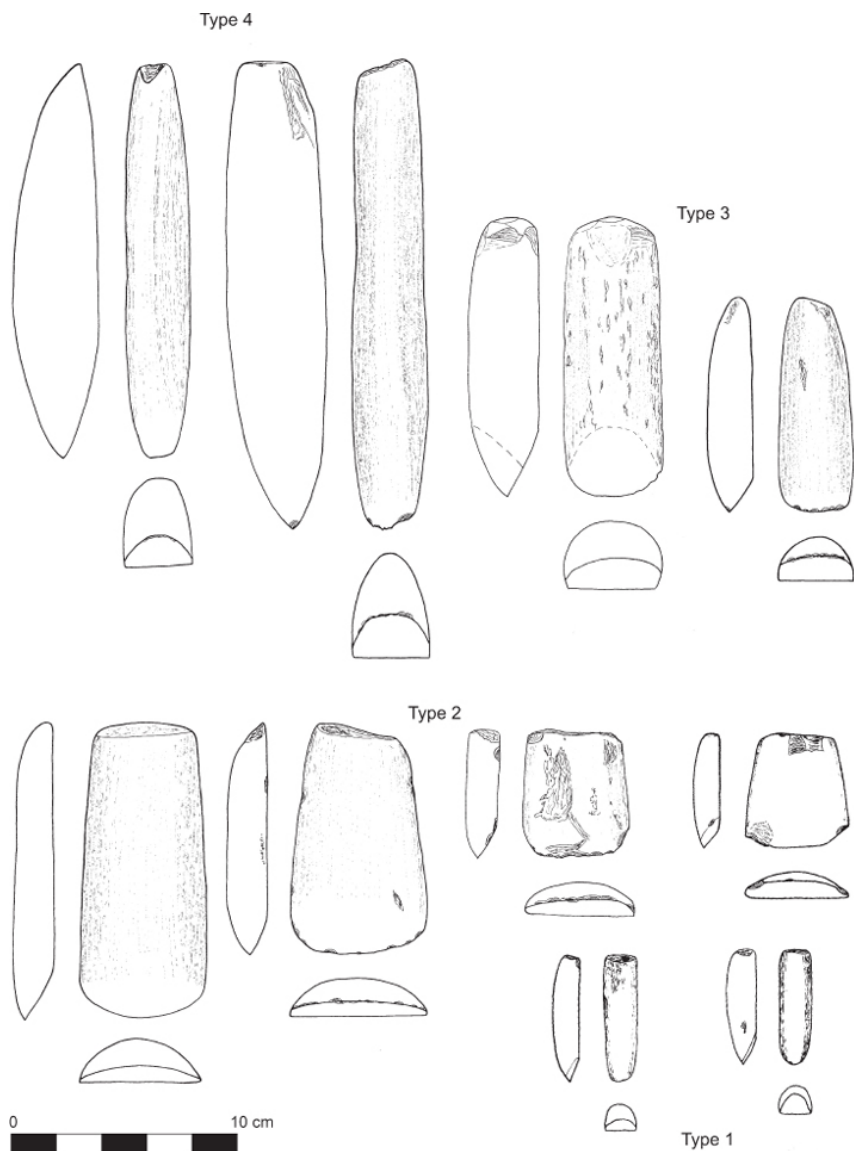


Figure 4. Adze types.

In addition, basalt, sedimentary rocks and lydite can be found in varying amounts. All these rocks are local in Hesse and they are therefore to be seen as regional raw materials. Basalt originates from different foothills of the Vogelsberg, from northern Hessian basalt peaks or from the Westerwald outcrops. Fine sedimentary rocks such as clay or siltstone can be found in different areas of Hesse in the formations of new red sandstone. Lydites could be obtained particularly

from the Kellerwald and other domains of the Rhenish Slate mountains, especially in the Lahn-Dill area. Amphibolite occurs at a smaller distance to some central Hessian settlements in minor inclusions in the crystalline Spessart and Odenwald. However, amphibolite was also used in many other settlement regions of the LBK distribution area and the origin of the material has been discussed for quite some time (e.g. Schwarz-Mackensen and Schneider 1983a; 1983b; 1986; Ramming 2007, 231 ff.). It is a widespread type of rock which occurs in different mountain areas of central Europe. Figure 8 shows LBK settlements in the western LBK distribution area and amphibolite sources. The circles represent settlements from which more than ten adzes and their raw materials are known. It shows that the northern Hessian sites are unusually rich in adzes even in the supra-regional comparison. An exception is Bylany in the Czech Republic with more than 1000 blades (Pavluš and Rulík 1991), alongside which one can mention the settlement of the Želiezovce-group at Bajč-Medzi kanálmi in Slovakia, likewise rich with more than 500 artefacts (Mérés *et al.* 2001). Such rich sites are otherwise rather rare. Amphibolites dominate in almost all the inventories, followed by basalt, other metamorphic rocks and sometimes fine sedimentary rocks.

Petrographic analysis

To investigate the origin and the exchange system of LBK adzes, one of the main questions is the petrographical and geochemical homo- or heterogeneity of the raw materials in different sites and regions. In case of a great homogeneity in mineralogical composition and rock geochemistry, an origin from a single mining area is to be assumed, whereas a great heterogeneity indicates the use of different outcrops.

Polarization-microscope investigations of thin sections from amphibolite artefacts show that in central Hesse different amphibolites were used for the production of adze blades. In northern Hesse, as well as in various other LBK settlements, for example Vaihingen-Enz, Müddersheim and several sites in the foothills of the Harz, only one amphibolite type occurs (Schüssler *et al.* 2006). Almost all investigated artefacts from these regions are made from actinolite-hornblende-schist, a type of amphibolite which was already described in the 1980s by Gesine Schwarz-Mackensen and Werner Schneider as the dominant adze raw material in the foothills of the Harz and in central Europe in general (Schwarz-Mackensen and Schneider 1983a; 1983b; 1986). They postulated that the source lay in the Balkan or Carpathian region, but without giving geochemical or petrographical evidence.

Indeed, actinolite-hornblende-schist is a quite rare metamorphic material, which can be distinguished from other, more common 'genuine' amphibolites. The rock texture of actinolite-hornblende-schist is characterized by the needle-like arrangement of yellowish to greenish actinolites, which grew together with quartz and/or chlorite. Plagioclase is present as the second main mineral (Figure 9a). Moreover, large portions of ore minerals are characteristic. The group comprises very fine-grained to aphanitic actinolite and hornblende minerals alongside more coarse-grained varieties. Lighter thin stripes built of plagioclase and quartz alternate with darker greenish-grey or nearly black stripes composed of actinolite and hornblende with a higher content of opaque minerals. Actinolite-hornblende-

schist could be identified for every investigated northern Hessian artefact and for 74 % of the analyzed amphibolites from central Hesse. The structure and the mineral composition of all actinolite-hornblende-schist samples are very uniform and this material is proven in all examined areas.

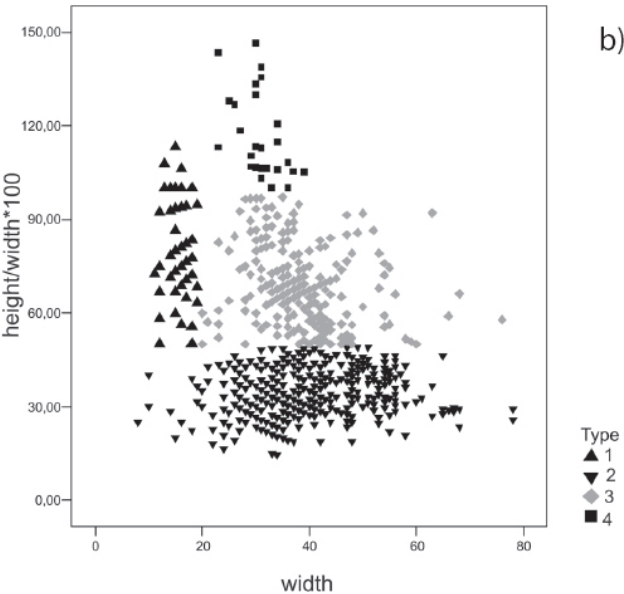
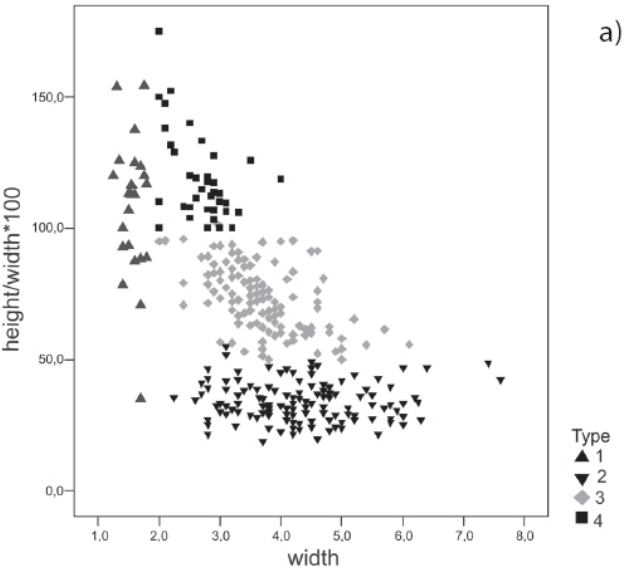


Figure 5. Metric characteristics of adze blades. a) Adzes from LBK cemeteries in central Europe. b) Adzes from LBK sites in central and northern Hesse.

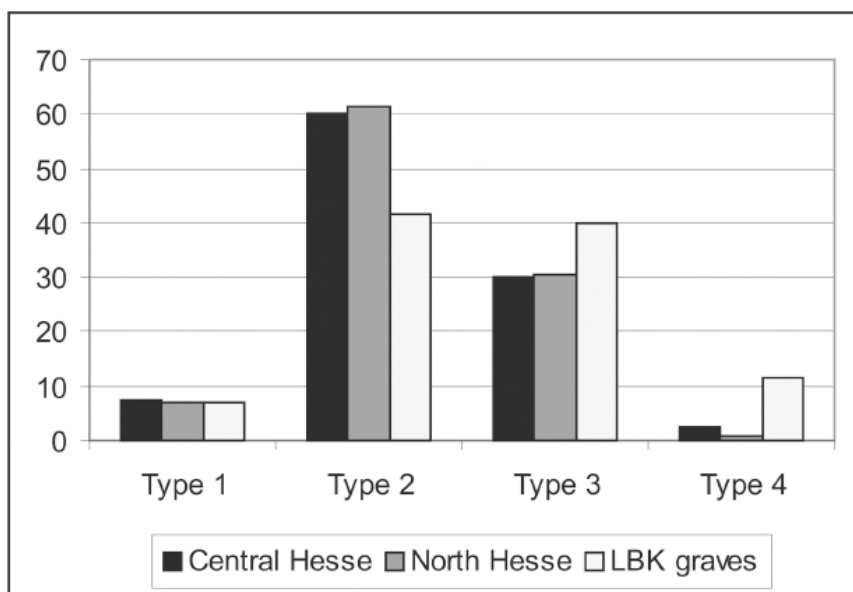


Figure 6. Percentages of adze types in LBK settlements and graves.

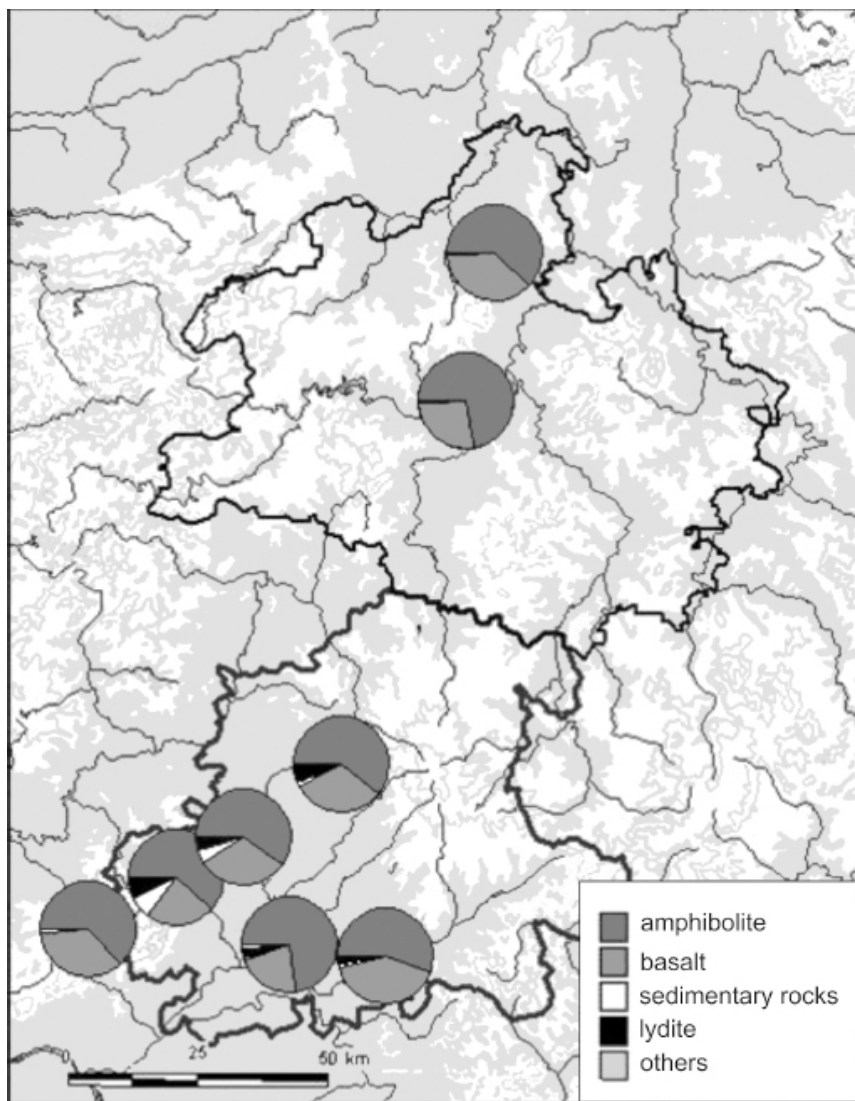


Figure 7. Raw material distribution in several micro-regions in central and northern Hesse.

In central Hesse several types of ‘genuine amphibolites’ appear beside actinolite-hornblende schist, which are not to be found in other study areas (Figure 9b). This kind of rock is characterised by a robust to light schistose structure, in which greenish amphiboles and bright hornblende occur in different portions. Ore minerals are rare, and in most cases are missing completely. The structures of the samples are rather different. In one case the hornblendes are enclosed in a ‘nest-like’ manner by amphiboles. This variety occurs near Omersbach in the Spessart.

The other amphibolite varieties are unspecific, so that they cannot be assigned a certain source petrographically (Christensen and Ramming 2004).

For this reason, the geochemical composition of the different amphibolites was determined by X-ray analysis. The ten main and 14 rare elements measured were examined in a principal component analysis regarding their similarity. The petrographically similar actinolite-hornblende schists from northern and central Hesse also correspond geochemically, as against the ‘genuine’ amphibolites from central Hesse, which can be clearly differentiated. All samples are relatively poor in aluminium and silicon. Therefore, we infer that in their early history (before metamorphism) these rocks started out as basalts. In a discrimination diagram of zircon, titanium and yttrium the two groups can again be separated clearly (Figure 10). It shows that the ‘genuine’ amphibolites developed from Mid-ocean Ridge basalt; in contrast, for the actinolite-hornblende-schist Oceanic Island basalt could be proven as output rock.

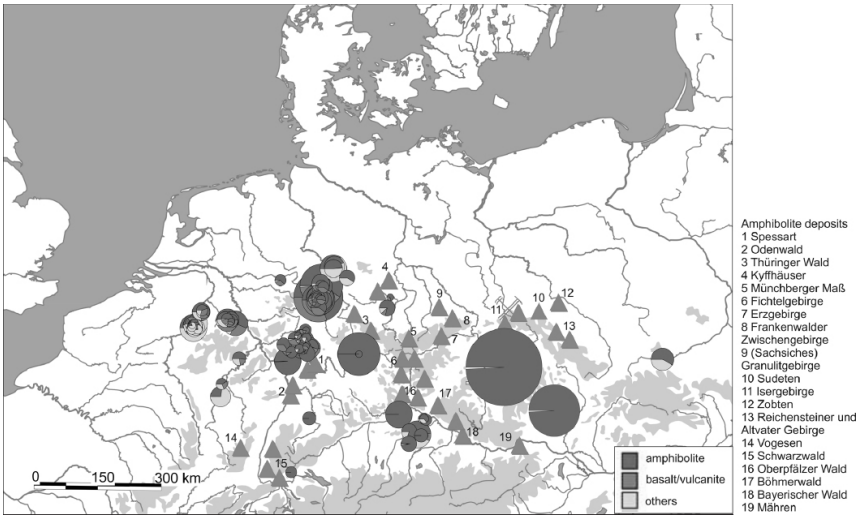


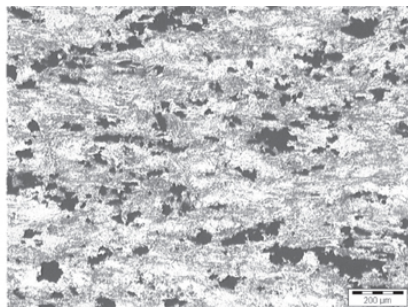
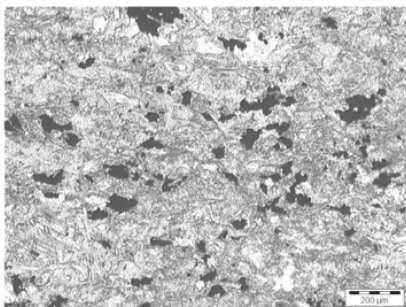
Figure 8. Raw materials on LBK sites with at least 10 adze blades and amphibolite deposits in central Europe.

A geochemical comparison with artefacts from other regions and reference samples from several amphibolite outcrops shows that most artefacts present very similar chemical compositions to the actinolite-hornblende-schist, whereas the reference samples are quite heterogeneous. In a stray diagram based on the first and the third factor of a principal component analysis of the elements Si, Ti, Al, Mn, Mg, Ca, Na, K and P, only the reference samples from the Fichtel and Isera Mountains cluster with the major artefact group (Figure 11). Only the artefact samples from ‘genuine’ amphibolites stray into the broad field of the reference samples. Most reference samples are characterised as ‘genuine’ amphibolites and are therefore only applicable as an origin area for the few ‘genuine’ amphibolites from central Hesse. For the artefacts made of actinolite-hornblende-schists, only the Fichtel Mountains and the Bohemian Isera Mountains are possible source areas

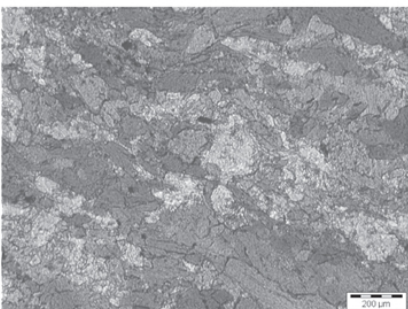
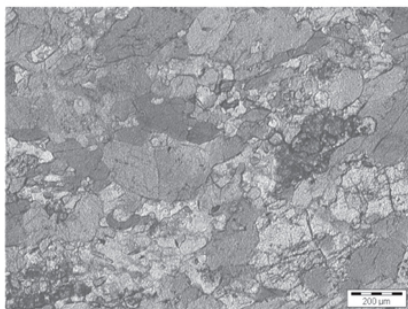
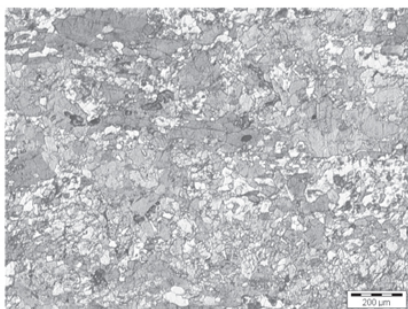
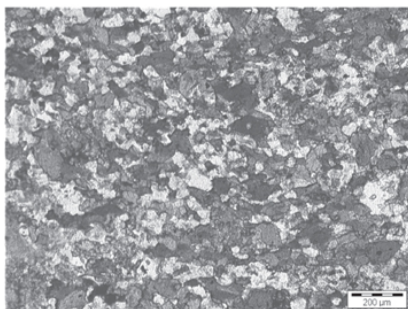
(see also Christensen *et al.* 2006).

The Ižera Mountains (Czech Jizerské hory), part of the Sudetes, are the source area of Jizera and Luzická Níža. In late medieval and modern times, glass production and ore smelting were carried out alongside a forest and pastoral industry, which led to the clearing of larger forest areas and concomitantly to the partial destruction of Neolithic sites. The typical rock of the Ižera Mountains is granite, which is traversed by contact-metamorphic rocks in the south (Šrein *et al.* 2002). Its connection with Neolithic raw materials was already pointed out early on (Huyer 1914; Gränzer 1933). In 1964, these metamorphic rocks were still listed as 'jade' in mineralogical maps (Kratochvíl 1957–1964), but today they are designated as amphibolitic hornfels by Czech mineralogists (Šrein *et al.* 2002). This material agrees geochemically and petrographically with the adze raw material described by Werner Schneider in the 1980s as actinolite-hornblende-schist.

In 2002, a Neolithic quarry site with a large number of chipped rock tools and flakes was discovered at the southern rim of the Ižera Mountains near Jistebsko in the cadastre Jablonec nad Nisou (Šrein *et al.* 2002). After long-term archaeometric investigations of numerous rock artefacts by Czech and Slovak mineralogists and comparisons with appropriate reference material from different deposits, the first quarry for early and middle Neolithic adze raw material could be located. This find triggered an archaeological survey, which has been under way since 2002. Rock extraction sites, unlike flint mines, are altogether much more exceptional in the European Neolithic.



a) Actinolite-hornblende-schist is the main raw material in most LBK settlement regions



b) Different types of amphibolite identified on adze blades from central Hesse

Figure 9. Thin sections. a) Actinolite-hornblende-schist. b) ‘Genuine’ amphibolites from central Hesse.

In the meantime, four further quarries were discovered in the closer environment of Jistebsko. In Jistebsko 1, the largest site with quarrying traces so far, rock blocks were exploited from sinkholes with diameters of up to 10 m and depths of up to 3 m under today’s land surface. The extraction area extends over a broad band roughly 800 m in length and 100 to 350 m wide. In an area of 15.4 hectares, approximately 500 to 650 sinkholes can be counted. Small-scale excavations in the years 2004 and 2005 produced numerous scraps and semi-finished artefacts, ditch 1 also yielded charcoal. The derived C-14 date falls with

79 % probability into the period 5150 to 4900 cal BC (Prostředník *et al.* 2005). Blanks and semifinished products from this rock are common in Linear and Stroke Ornamented Pottery settlements in Bohemia. The quarrying therefore already took place in the early phases of the Neolithic. Two further quarries lay in the Jistebsko area. Jistebsko 2, placed on the summit of the Maršovice hill, is visibly smaller, with only 4.1 hectares and about 50 to 150 sinkholes. Between Jistebsko 1 and 2 lies the even smaller site of Jistebsko 3, covering about 1.3 hectares and with likewise about 50 to 150 sinkholes. Today the area between these three sites shows no more traces of Neolithic quarrying, due to forest vegetation and land development.

The contact-metamorphic rock band continues further towards Maršovice, and it seems to be one large mining area. With an area of 0.4 hectares, the Maršovice 1 site is the smallest extraction area still locatable today, with traces of some few smaller sinkholes. Another site, Velké Hamry 1, was discovered and published in 2002 by Antonín Přichystal of the Mineralogical Institute of the University of Brno (Přichystal 2002). This place encompasses an area of approximately one hectare. Positive extraction traces were not yet found. In 2004, another site of about 38 hectares was discovered by the archaeologist Petr Šída in the cadastre Velké Hamry, however, it had been destroyed by medieval agriculture. Today, the levelled area is to a large extent covered by grassland and sinkholes in the area are no longer visible. However, in field clearance cairns flakes and semi-finished products of Neolithic adze blades were found. Thus, according to the present state of knowledge of Czech archaeology, an extraction area of altogether at least one square kilometre, but probably even larger, can be expected in the Ižera Mountains (Prostředník *et al.* 2005, 480).

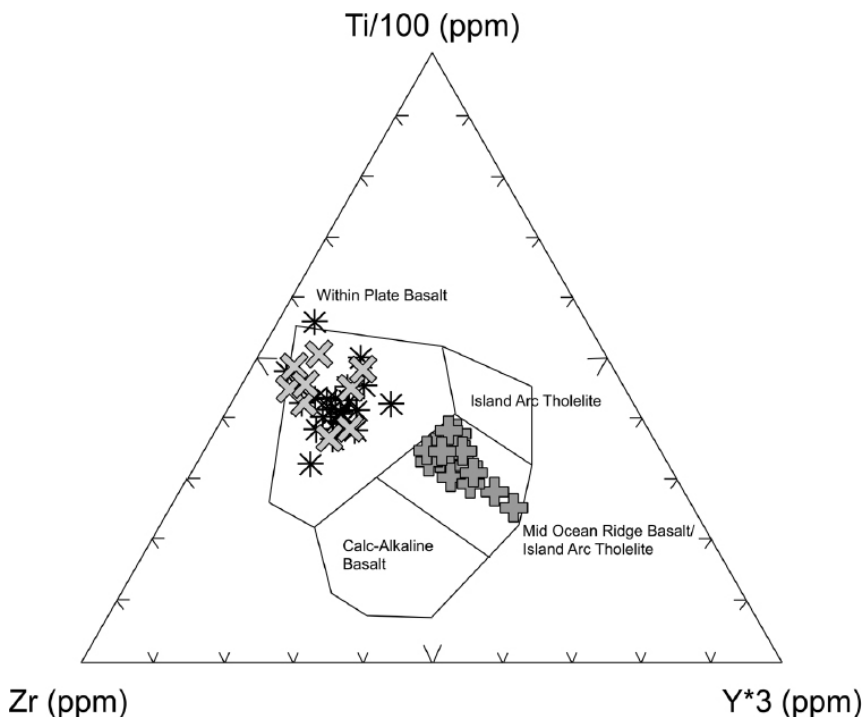


Figure 10. Discrimination diagram of zircon, titanium and yttrium. Stars: central Hesse actinolite-hornblende-schist. Crosses: central Hesse 'genuine' amphibolite. X: north Hesse actinolite-hornblende-schist.

First calculations estimate an annual output of approximately 1000 to 2000 adze blades. The result is based on test runs counting numbers of artefacts from the single ditches. On an area of 1 m², approximately 100 flakes were found. This yields a sum total number of trillions of scraps for the entire extraction area. Presuming that each blank is produced by knapping up to 50–100 flakes, we can therefore calculate up to 1–2 million blanks in a quarrying period spanning about 500 years. Not every prefabricated blank will have reached its end consumer; a certain part will have been rejected due to ineligibility. Nevertheless, the annual production rate in the Jistebko quarrying area amounted to approximately 2000–4000 adze blades. This means that an average of around five to ten blades must have been created daily, as long as production was not a seasonal event.

Trying to contrast production output with the requirement of adzes in a certain area leads to some difficulties. To evaluate the need for adze blades, the number of LBK houses to supply is crucial, as well as the 'life span' of the different types of adze blades. Convincing archaeological experiments on durability and wear marks of adze blades are still to come. On the basis of a regular edging and half of the tool being covered by hafting, a model of durability to minimum functionality can be formulated. In my estimation, an adze blade could be in use about 8 to 15 years by regular re-sharpening, if it did not break under pressure (Ramming 2007, 261

ff.).

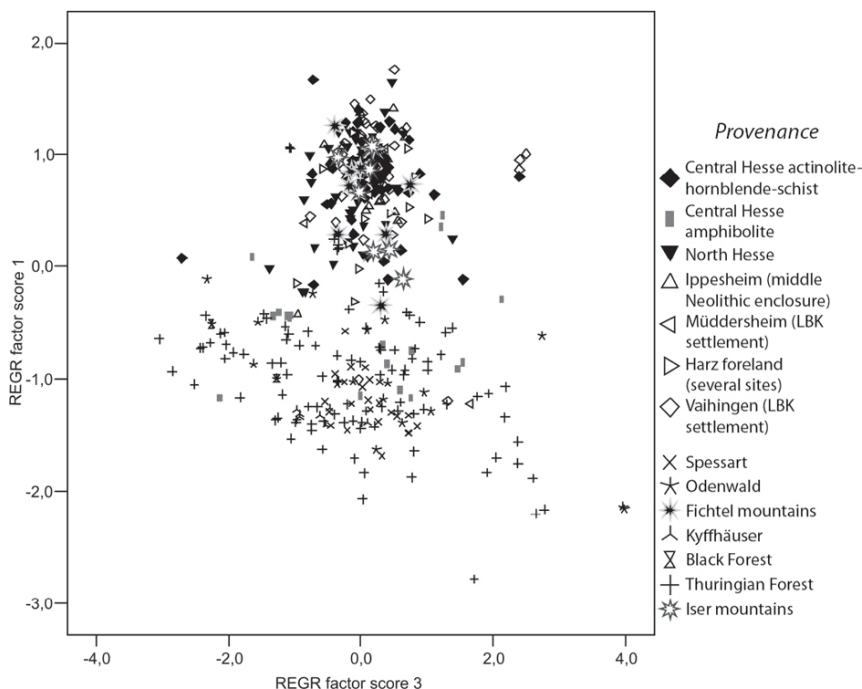


Figure 11. Scatter diagram based on the first and third component of a principal component analysis.

A comparison of the average number of adzes per house in different LBK settlements shows a clear distribution difference. Returning to the settlement of Bylany with far more than 1000 artefacts, an average of about 9.1 adze blades per household was found. According to estimates by Ivan Pavlů, a single working person in Bylany would have used up to 3–5 adzes during a single year. With a settlement phase lasting 15–30 years and one to two persons capable of work per household, between a minimum of 45 and a maximum of 300 adzes per house can be suggested, which, considering the ‘life-span’ of an adze, leads to 172.5 specimens for each house in Bylany (Pavlů and Rulf 1991, 325 ff.). This, however, seems a bit exaggerated. Comparing the average amount of adzes to a sample of 28 known LBK settlements shows that less than one polished artefact was found per house; on average about 2.3 adzes per house (Figure 12). According to my estimates, based on waste frequency, functional minimum sizes and considerations concerning the frequency of re-sharpening, the average number of adzes per house is 6 (Ramminger 2007, 268).

Using the example of the Mörlener Bucht, a micro-region in central Hesse with dimensions of 6 x 12 km, a data model of raw material demand for adze production can be formulated. For this micro-region, data concerning population density and number of households exist, which makes it more suitable for this kind

of investigation than other regions. According to calculations of population density by Christoph Schade, as well as by Klaus Peter Wendt and Andreas Zimmermann, as many as 0.8 or at most 1.3 households per square kilometre existed in the Mörlener Bucht during the time of the Linear Pottery culture (Schade 2004, 223 ff.; Zimmermann and Wendt 2003, 494). During a settlement phase of 25 years, a minimum of 57.6 and a maximum of 91 households would therefore have existed in this 72 km² micro-region. Over 500 years of LBK occupation and 20 house-generations, therefore, as many as 1,150 or maximally 1,820 houses will have existed. Assuming a rather constant distribution of adzes in the house inventories within one settlement, but different quantities when comparing different settlements, more or less 6.2 adzes per house can be estimated. In total, a number between 7,142 and 11,284 adze blades would be expected in the Mörlener Bucht for the LBK. Proportional distribution would be 60% flat adzes type 2, about 33% high and medium high adzes type 3 and 4 and 7% miniature adzes type 1. The yearly requirement of adze blades of the inhabitants in the Mörlener Bucht would therefore lie between 14 and 23 pieces.

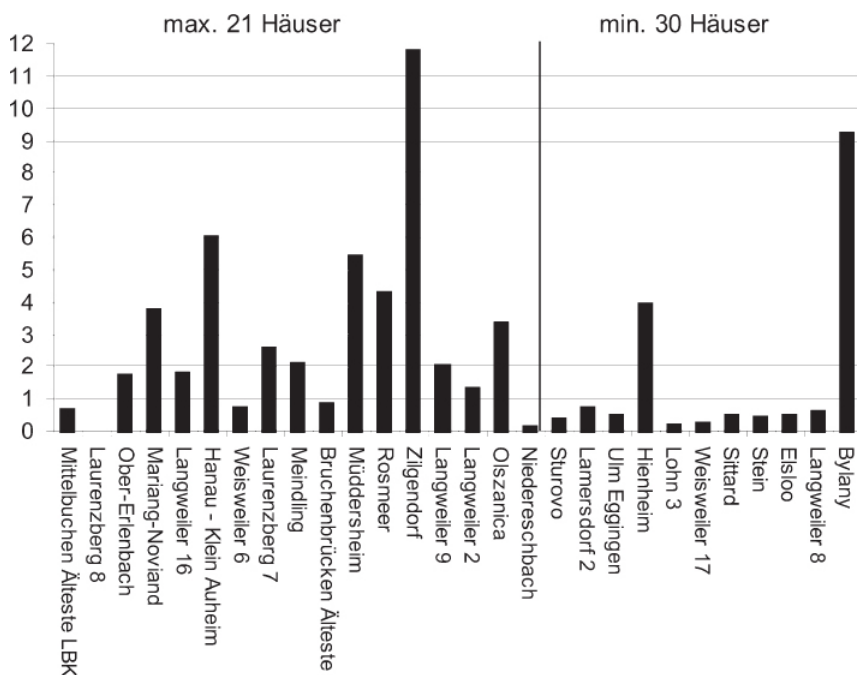


Figure 12. Average number of adzes per house in LBK sites. Left: sites with no more than 21 houses. Right: sites with at least 30 houses.

Transferring these data to the western LBK distribution area, we can get an idea of the overall need for adze blades during the early Neolithic in central Europe. Zimmermann *et al.* (2004) calculated the number of contemporaneous households during one settlement phase of the later LBK in the western part of its distribution area (Germany and surroundings). According to site densities in the key regions

‘Rheinische Bucht’, ‘Neuwieder Basin’, ‘Main Triangle’ and ‘northern Wetterau’, they assume a total number of 18,587 contemporaneous households for one settlement phase of 25 years (Zimmermann *et al.* 2004, 80 ff.). Supposing each household averaged six adzes, we can calculate a need of 111,522 adze blades within a timespan of 25 years. The average production rate of blades at Jistebsko over 25 years is 50,000 to 100,000 pieces, and therefore in the later LBK the demand for adze blades cannot be supplied by the Jistebsko raw material alone.

During the early phase of the Linear Pottery culture in central Hesse, imported actinolite-hornblende-schist was used almost exclusively (Figure 13). With increasing population density and thus increased demand, regionally available rock deposits are utilized. In settlements with pure Flomborn inventories, 70–80% of adzes are imported. However, on late LBK sites, basalts are the dominant raw material for adze production. Mapping exclusively the middle and late LBK sites, an axis with high basalt density is visible from Vogelsberg to the Taunus, running through the central Wetterau (Figure 14). In contrast, sites in the south and in the northwest show lower basalt values. In the later LBK, ‘genuine’ amphibolites arrived into the area from a southern direction, while lydite from the Lahn-Dill area reached it from the north. On all these sites, imported actinolite-hornblende-schist is still found, although in clearly lower proportions.

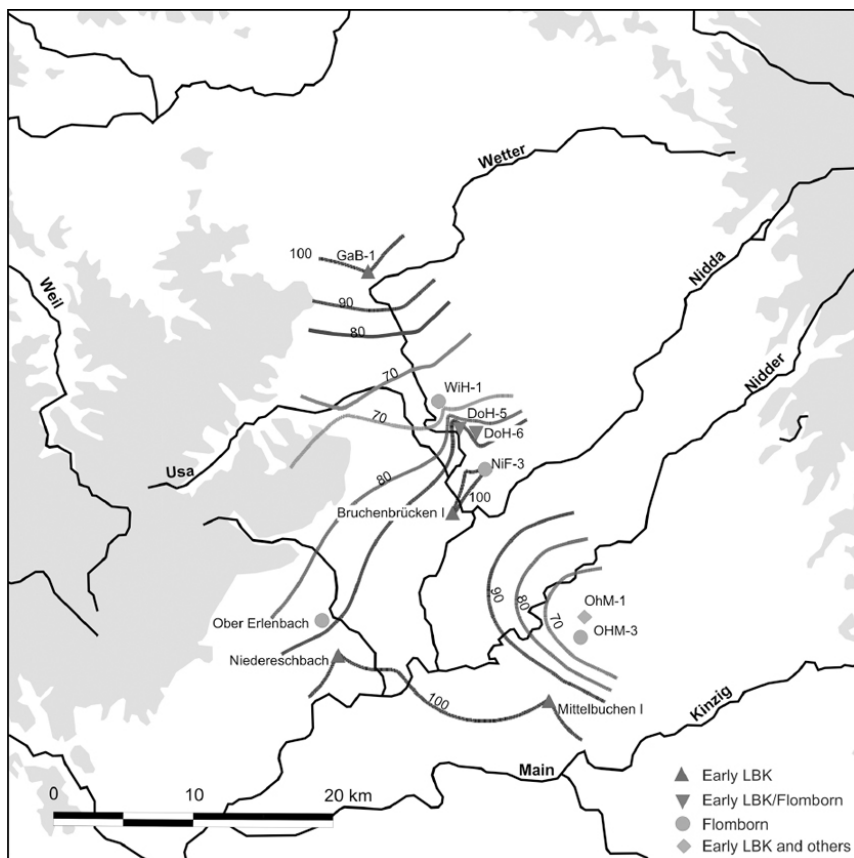


Figure 13. Amphibolite percentages in early LBK and Flomborn inventories in central Hesse.

Conclusions

In summary, it can be noted that most adze blades from northern and central Hesse were produced of non-local raw materials, although sufficiently useful rocks occur in the closer environment. Actinolite-hornblende-schist is also found in all other examined early and middle Neolithic settlement areas. An exchange system ranging over wider parts of central Europe can therefore be suggested. Hence, the supply of raw material for adzes took place in a different way than for instance the supply of querns, which are more regional in origin. Usefulness and availability of the raw material were not the only crucial factors; in particular the homogeneity of the actinolite-hornblende-schist and its large scale distribution also seem to reflect a special value attached to this material. During the early LBK, the need for adze blades could be satisfied from the source in the Bohemian Isera Mountains, whereas in later LBK phases, local raw materials such as basalt and sedimentary rocks were increasingly used. An attribution of value which is based exclusively on rarity is out of the question for the actinolite-hornblende-schist, since it dominates

in all Hessian micro-regions. The predominance of this special rock in many LBK settlement areas suggests a preference which can be connected either to the quality of the rock or to the acquisition of the artefacts itself. Beside the functional value, it is possible that the long-distance trade of imported raw materials also served as an indicator for group affiliation and an expression of identity. Therefore, social relations could have been stabilized by the exchange of adzes. The further examination of the exchange system of early Neolithic adze blades is the challenge of a future interdisciplinary project, which is financed by the Deutsche Forschungsgemeinschaft.

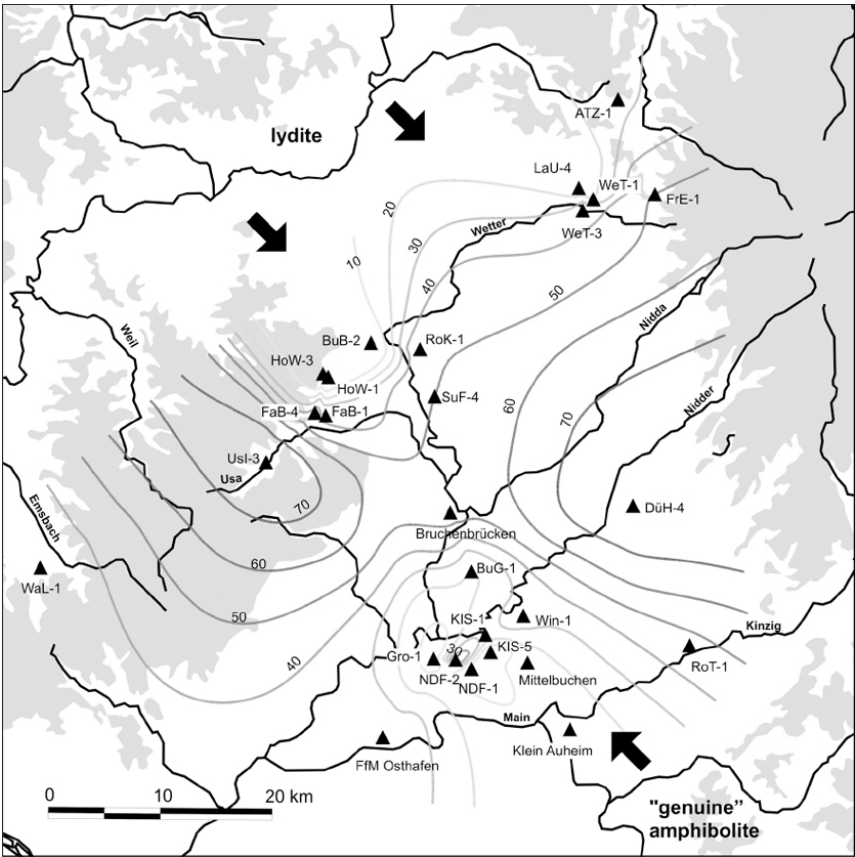


Figure 14. Basalt percentages in later LBK inventories in central Hesse.

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Settlement history, land use and social networks of early Neolithic communities in western Germany

Erich Claßen

This paper offers a description and analysis of the social relations which existed between early Neolithic settlements by applying methods from 'Social Network Analysis' (e.g. Wasserman and Faust 1994). It introduces fundamental concepts and methodological basics, as well as the results of this new approach with regards to social and economic networks existing within prehistoric societies. It must be stressed that this approach is only possible because of a long history of systematic data collection from early Neolithic settlements in the Rhineland; for this reason, a summary of this research, which has been conducted over the last 40 years, is also provided.

I begin with a brief summary of early Neolithic research history in the Rhineland¹ and go on to describe methodological principles and models concerning settlement structure and history, which in turn lead to a summary of these aspects. The state of research on exchange systems and social structure will be followed by the introduction of network analytical concepts which are fundamental for the further methodological approach presented here. Finally, the results of this research are summarised.

History of research

The Linearbandkeramik (LBK)² is the material culture associated with the first Neolithic settlers in central Europe. Their settlements are found in an area between the Carpathian Mountains in the east and the Paris Basin in the west. From the earliest phase, between 5500 and 5300 cal BC, LBK sites are known only from areas east of the Rhine (cf. Lüning 1988, fig. 4). After 5300 cal BC, the LBK occupation of the Lower Rhine Basin begins (Figure 1). In this region, where approximately 120 early Neolithic settlements have so far been located, the focus of research lies in an area of lignite exploitation to the west of Cologne (Schwellnus 1983). However, this line of research, which began in the mid 1960s, was preceded by the seminal excavation of Köln-Lindenthal by Buttler and Haberey (Buttler and Haberey 1936; Bernhardt 1986) and also by groundbreaking research in the Graetheide (Limburg, NL) in the 1950s (Modderman 1959;

Waterbolk 1959).

In the lignite mining area of western Germany, the LBK settlements discovered on the 'Aldenhovener Platte' have been a major concern in recent decades. The project 'Siedlungsarchäologie der Aldenhovener Platte im Rheinland',³ conducted between 1971 and 1981 and financed by the German Research Foundation (DFG), undertook large-scale excavations in the Merzbach valley and yielded an essential contribution to our knowledge of early Neolithic settlement history in this part of western Germany. Here, in the southwestern part of the mining area, an almost completely excavated group of settlements along the Merzbach valley – with six settlements, one cemetery and three enclosures – has been examined and published (Farruggia *et al.* 1973; Kuper *et al.* 1977; Boelicke *et al.* 1988; Lüning 1982a; 1982b; 1997a; Lüning and Stehli 1994; Stehli 1989).

Three kilometres to the east, the Schlangengraben valley has yielded a further six settlements. These were, however, not as extensively excavated as those along the Merzbach valley. Five of these sites have recently been published (Krahn 2006; Rück 2007) and a further settlement has been examined, but not yet published (Bollig 2000; Kolhoff 1999).

The recently concluded project 'Landschafts-archäologie des Neolithikums in Rheinischen Braunkohlerevier' (LAN; 1998–2004)⁴ has concentrated on a further agglomeration of LBK settlements near Inden (Frank *et al.* 2000; Zimmermann 2001; 2002; Zimmermann *et al.* 2004). Here, in the eastern part of the Aldenhovener Platte, c. 20 % of two settlements and one cemetery in the Altdorfer Tälchen have been excavated. Two M.A. dissertations have been completed (Clare 2004; Heller 2004) and a PhD dissertation is in progress (Mischka in prep.). Yet another settlement, two kilometres to the south, on the western bank of the Inde, has also been subject to analyses (Lüning and Stehli 1992). Therefore, the database and state of research for the Aldenhovener Platte can be considered to be exceptional.

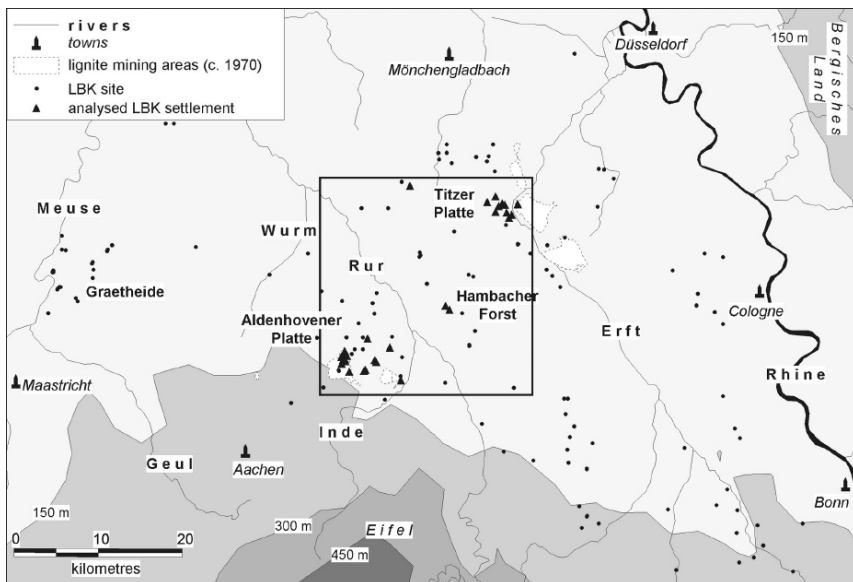


Figure 1. Simplified map of the Rhineland (D) and Limburg (NL, B) indicating the main research areas, the lignite mining areas, known LBK sites, as well as the analysed LBK settlements forming the basis for this study. The square in the middle of the figure circumscribes the main area used in network analyses (cf. Figure 3). LBK sites in the Rhineland after Claßen and Richter (1997), LBK sites in Limburg after Modderman 1970.

To the west of the river Rur, in the so-called Hambacher Forst, survey conditions are not as favourable as in neighbouring areas, where agricultural cultivation is predominant. Consequently, only a few sites have been partly excavated; however, as analysis is complete, the state of research for this area can be considered sufficient (Cladders 1997; Hohmeyer 1997; Erkelenz 2002; Reepmeyer 2002). About 15 km to the north lies the site of Kückhoven – known for its exceptionally preserved wooden well (Weiner and Lehmann 1999) – which has recently been published (Koschik 2004).

Only a short distance to the east, a loess plateau known as Titzer Platte is being destroyed by opencast mining. Here, several LBK settlements have been discovered in the course of survey work, some of which have been subject to small-scale excavation work by the responsible Monuments Council (Rheinisches Amt für Bodendenkmalpflege). On the Titzer Platte, an area of 18 km², a total of 15 LBK settlements located near the former village of Königshoven have been studied in the course of one PhD (Claßen 2006a) and three M.A. dissertations (Claßen 1998; 1999; Schweinehagen 1990; Schulz 1991). It was in the course of the former that the methodological approach of ‘Social Network Analysis’ was applied to the archaeological data.

It is hoped that this paper, which focuses on settlement structures and social networks, together with some further paragraphs in a paper on ‘landscape archaeology’ to be published shortly (Zimmermann *et al.* in press), will serve to

summarise the state of LBK research in the Rhineland.

Models of settlement structure

For the LBK an understanding of certain key terms and models, the majority of which were defined by the research group working in the Merzbach valley (cf. Lüning 1997b, 43), is essential. Accordingly, these models of settlement structure and development form the basis of landscape archaeological research into the LBK of the Rhineland.⁵

The basic unit is the LBK longhouse, with its wall trenches, wall posts, and inner posts, as described for example by Modderman (1970).

A 'yard'⁶ (Ger.: Hof) is the basic unit constituting LBK settlements and comprises a house with its corresponding pits. The term 'house generation' [HG] is used to describe the temporal dimension of one yard.

In the model, pits are found alongside the house walls, and to the west, north and east of the structure at a distance of no more than 25 metres (Boelicke 1982, 17–20; cf. Claßen 2005, 114, fig. 1). Main arguments for the contemporaneity of both the pits and the house are on the one hand refitted sherds of pottery from different pits, and on the other the proximity of the pits in a subsequent correspondence analysis. The settlement Königshoven 4 (FR 122) can be regarded as a prime example of a LBK yard (Claßen 1998; 1999; 2005, 115, fig. 2). The distribution of different find categories suggests that within this socio-economic unit different activity zones, or at least dumping zones, existed.

The 'farmstead' (Ger.: Hofplatz) is that part of a settlement, or a settlement as a whole (single farmstead settlement), which shows a local sequence of several yards of consecutive house generations. The structure of a farmstead results from the temporal succession in which the individual yards were founded.

The principal assumption in the so called 'Hofplatz-modell' is that LBK settlements represent continuously occupied areas, with localised sequences of single yards. This model was developed on the basis of excavations at Langweiler 2 (Farruggia *et al.* 1973) and Langweiler 9 (Kuper *et al.* 1977), where areas devoid of houses were shown to separate distinct local house groups (cf. Claßen 2005, 116, fig. 3).

These two models – a yard comprising a house with a surrounding economic area extending in a radius of 25 m around the structure, and a continuous succession of yards within a restricted part of a settlement (farmstead) – led to certain conclusions in the reconstruction of the settlement history of the Merzbach Valley (cf. Boelicke *et al.* 1988, fig. 732; Claßen 2005, 117, fig. 4). Firstly, contemporaneous houses should be separated at least by the stipulated spatial dimension, and secondly, non-simultaneous houses may be situated in closer proximity, but should be clearly separated in time.

For establishing the chronological sequence of the houses, seriation or correspondence analysis is considered the adequate method. Although methodological and chronological details will not be discussed here, it should be noted that the chronological frame referred to in the following is based on a correspondence analysis of 10,052 vessel units which were recovered from 1,677 pits at 34 LBK settlements in the Rhineland. In the correspondence analyses produced over the last decades, LBK pits are understood as units, and the main

decorative motifs applied to the pottery are regarded as types. Thus, a settlement pit is regarded as representing a closed archaeological context. A reconstruction of settlement development requires the identification of groups of pits forming temporal-spatial units, for which cluster analyses can be used. Due to the regular arrangement of pits in the vicinity of houses, individual yards can be dated and placed within a chronological sequence, resulting in the identification of farmsteads.

The sequence calculated for the settlements in the Merzbach valley led to the identification of at least 14 house generations, each comprising roughly 25 years on average, and which constitute the c. 350 years of LBK settlement activity in the Rhineland (Münch 1999; Stehli 1989, fig. 8–11; 1994, 84–121). This chronology has also proved valid for other settlements within the Lower Rhine basin (Lehmann 2004; Krahn 2006).

The data on the settlements near Königshoven (Claßen 2006a) is less detailed than was the case for the Merzbach valley, mainly due to the fact that the Königshoven sites were only excavated in small parts. However, using the aforementioned models it proved possible to determine both the beginning and end of occupation, as well as to calculate minimum and maximum estimates of the number of simultaneous households.

Settlement history

LBK settlements, which are mostly situated along rivulets, consist of either an individual farmstead or several simultaneous farmsteads (e.g. Lüning and Stehli 1989; Stehli 1994; Zimmermann 2002). In these settlements different occupation densities, i.e. differing numbers of contemporaneous houses, can be observed.

The occupation of the Rhineland commences at roughly 5300 cal BC. In this period, pioneer settlements comprising two to four houses were established in the southwestern part of the research area (Zimmermann 2002, fig. 8). The distance between these first settlements is 2 to 3 km. In the subsequent house generation(s), single farmstead settlements were founded in the vicinity of these pioneer settlements (Zimmermann 2002, fig. 9) and new pioneer settlements at a greater distance occupied the northern part of the research area. By about 5150 cal BC (HG VII) some single household settlements had grown and developed into medium-sized hamlets with two or three contemporaneous households (Zimmermann 2002, fig.10). Parallel to this development, the number of houses increases continuously in those hamlets which had been founded first. After house generation X, a three-fold settlement structure with a main settlement, several secondary settlements and/or single farmstead settlements can be observed in the Merzbach valley (Zimmermann 2002, fig. 11). The maximum occupation density is reached in house generation XII at about 5000 cal BC. However, within two to three generations there follows a rapid and dramatic decrease in LBK occupation density, which leads ultimately to the end of LBK settlement in the Rhineland. For a period of about 50 years after 4950 cal BC there are no clear settlement signals in the archaeological data (Zimmermann *et al.* 2006, 177–79). Further, the palynological data show a regeneration of woodland, which has been interpreted as resulting from reduced settlement activity in the area (cf. Kalis and Meurers-Balke 1997, 35).

Topographical clusters of settlements which differ in size and duration, as in the Merzbach or Schlangengraben valleys, are summarised as settlement groups (Ger. Siedlungsgruppe).⁷ Concerning the structure of these groups, the Merzbach valley is seen as the best example. The three-fold system mentioned above comprises a main settlement with up to ten households, which was inhabited continuously from the older LBK onwards; secondary settlements, which are medium-sized hamlets with two to four simultaneous households; and single farmstead settlements with one yard in each generation and which were occupied for either a few generations or alternatively for a longer time span. In settlement groups other than the Merzbach valley, settlement history follows a very similar line, but as these sites are not as extensively excavated, the processes involved in settlement development cannot be described in any detail. Nevertheless, estimates can still be made with respect to the number of simultaneous households within the different settlement groups. Functional differences between the settlements in these groups can be distinguished. However, in order to reconstruct the territory for farming and stockbreeding in the LBK, the single farmstead has to be seen as the principal production unit (domestic mode of production) and therefore represents the basis for adequate estimates regarding land use.

Land Use

On the basis of settlement size and duration we can, with the help of palynological, zoological and ethnographic data, estimate the amount of land required by individual settlements for crop cultivation and grazing. To model LBK land use in the settlement group near Königshoven, a value of 0.5 hectare of land per yard was set according to the abovementioned model of a typical LBK yard. To calculate the need for farming and stockbreeding, it is proposed that each LBK house was inhabited by six people (cf. Lüning 1988, 38, note 33; Stehli 1994, 109; Ebersbach and Schade 2004, 3; Zimmermann *et al.* in press). On the basis of these factors, the area of arable land is reconstructed as 2 hectares per yard and that for grazing as 30 hectares per yard (cf. Bakels 1982; Bogucki 1982; Gregg 1988; Lüning 1988; 2000; Ebersbach 2002; Zimmermann 2002; Ebersbach and Schade 2004).

Although the floodplains are also suitable for grazing, in the Königshoven study only loess soils are regarded as potential agricultural area when modelling the fields and pastures for different phases of the LBK (Claßen 2006b, 162–64, fig. 11–15). In summary, the land use models allow the following conclusions:

In the ‘pioneer phase’ (house generation II) of the settlement group near Königshoven, the areas required for agriculture and grazing by the different settlements do not overlap (Claßen 2006b, fig. 11). However, with the gradual increase in population density in the following house generations, a slight overlap in pasture land can be discerned, particularly in the centre of the research area near Königshoven (Claßen 2006b, fig. 12). The further increase in the number of simultaneous farmsteads leads to a maximum occupation density in house generation XI, and at this time the surrounding landscape is used intensively; in some cases areas of arable land belonging to different settlements are now directly adjacent. Over half of the loess soils in the research area were used for grazing (Claßen 2006b, fig. 13). With the decreasing number of settlements towards the

end of the LBK, those areas which had shown a high exploitation in the preceding phases were now less intensively used (Claßen 2006b, fig. 13 and 14).

It should be noted, however, that although the models show an intensive use of the research area by the LBK population, it is extremely unlikely that a lack of farmland or pasture resulted in the collapse of LBK societies in the Rhineland. In fact, the Königshoven research area could have sustained at least twice the demand assumed here.

Raw material exchange

Our present understanding of the flint supply to LBK settlements in the Rhineland is based on models for which geographical, as well as socioeconomic aspects are seen as relevant. It is assumed that with increasing distance from the raw material source the frequency of discovering a high proportion of nodules or unmodified pieces with cortex within LBK inventories decreases. Thus, according to this model, the initial preparation – from nodules to cores – was conducted in settlements situated near the raw material sources. Subsequently, cores were exchanged down the line, accompanied by further processing along the way. Therefore, the greater the distance separating a settlement from the raw material source, the lower the amount of production waste (unmodified flakes and flakes with cortex) in its lithic assemblage. By the same token, there is an observable increase in the ratio of semi-finished products and final products (blades and tools) with increasing distance from the source (cf. Zimmermann 1995).

According to the models proposed by A. Zimmermann (1995), the exchange system between LBK settlements was hierarchical, i.e. it is assumed that certain settlements within the settlement groups produced a surplus of lithic artefacts. The inventories of these ‘producer settlements’ are marked by a high ratio of production waste. On the other hand, inventories of the ‘consumer settlements’ are characterised by a greater amount of semi-finished and final products. Therefore, in order to reconstruct the distribution of flint artefacts from one settlement to another, data relating to the amount of production waste, blades and final products from the different settlements is required (Zimmermann 1982; 1995). On the Aldenhovener Platte these data suggest different intensities of production and varying dominance of individual settlements in the distribution system, leading to a reconstruction of a rather complex system of raw material exchange (cf. Claßen and Zimmermann 2004, fig. 8).

The Aldenhovener Platte was mainly supplied with raw material from sources 40 km to the west, extracted from the chalks of the Lanaye-Lixhe-layers in the vicinity of Rijckholt (southern Limburg, NL, e.g. Felder *et al.* 1998, 5–16). In a first step, two main settlements were supplied directly from the source near Rijckholt. At these sites, a high proportion of blanks with cortex are a sure sign for the working of flint nodules and primary processing (Zimmermann 1988; Krahn 2006). These main settlements passed on cores, blades and final products to their direct neighbours (Langenbrink 1996; Gaffrey 1994; Krahn 2006). In one case, one main settlement may also have supplied a smaller settlement possibly not belonging to its own settlement group (Bollig 2000). A further main settlement produced an even greater number of artefacts than the two settlements already mentioned (Krahn 2006). However, these were not knapped from nodules but from prepared

cores. This means that this settlement was supplied by one or both of the aforementioned main settlements with primary products. It is probable that this main settlement passed on parts of the produced artefacts to other settlement groups (Deutmann 1997; Langenbrink 1992; Bender 1992; Hohmeyer 1997; Reepmeyer 2002). A further interesting aspect is the observable change in the position within the network hierarchy attested for two settlements in the course of the LBK period, i.e. a former producer settlement in the middle LBK became downgraded to consumer settlement in the later period (Reepmeyer 2002).

The above results and observations have led to the analysis of LBK raw material exchange networks using methods derived from social network analysis. The new results incorporating the data from the region near Königshoven are summarised below.

Pottery Analysis

For the recording of LBK pottery in the Rhineland, a rather elaborate documentation system has been established, which very much focuses on the applied decorations (Stehli 1973; 1977; 1988; Stehli and Strien unpublished; Schimmelschulze 1992; Schmidt 1997; Lehmann 2004; Krahn 2006). Investigations of LBK pottery designs usually result in a chronological ordering of the material which then serves as the basis for describing the development of local settlement structures, as discussed above (e.g. Stehli 1994). In addition to chronological studies, similarities in the decorative spectrum are also consulted for culture-historical interpretations (Friedrich 1994), or serve as a basis in the reconstruction of LBK social structure (van de Velde 1979). Here, I would like to focus on some of the most important points.

The older phases of the LBK are characterised by a homogenous inventory. The uniformity of the main ornamental motifs can be explained by a strong traditional background, which may have been watched over by a particular group within society (Friedrich 1994, 354). This conformity also implies that in the first 150 years of the Bandkeramik, no reason for conflict in the Rhineland was given. Following this initial phase of uniformity, which is coupled with population growth, a fast change and an increase in the main motifs of neighbouring settlements can be observed. This observation can be interpreted as a loss of authority for the group which had previously controlled pottery production. The change in ornamentation and the development of local traditions in the settlements can be seen as a strive for independence by the younger generation (Friedrich 1994, 355). Furthermore, it is proposed that the main motifs of LBK pottery reflect the traditions of single farmsteads (Friedrich 1994; Sommer 2001). Accepting the assumption that mainly women produced pottery, which is based on ethnographic analogies (Arnold 1985; Knopf 2002), it is assumed that decorative traditions were passed on from the older to the younger generation in the female line. Moreover, this gender-bound pottery production is suggestive of patrilocal residence rules, the existence of which is also discussed in other branches of investigation briefly summarised in the following.

So far, the only detailed investigation of the social conditions in LBK communities is that of P. van de Velde (1979, 79–173). In short, his study pursues three different approaches towards the analysis and interpretation of the

settlement and cemetery at Elsloo (Limburg, NL; Modderman 1970) and the settlement at Hienheim (Bavaria, DE; Modderman 1977). Starting with a neo-evolutionary stance, he interprets the social structure of the LBK as that of a ranked society (Fried 1967; Service 1962). This is followed by a structuralist approach (Lévi-Strauss 1963) which leads to the reconstruction of matrilineal descent and patrilineal residence rules within the LBK. However, from the neo-Marxist viewpoint favoured by van de Velde (Godelier 1975; 1978; Sahlins 2004), LBK society is based on the lineage mode of production, a production mode based on larger kinship groups incorporating several domestic units (farmsteads). Similar results were obtained from the study of LBK settlement groups on the Filder plateau (Baden-Württemberg, DE; Strien 2000). Strien assumes patrilocal residence rules owing to far-reaching similarities in pottery decoration and only slight differences in flint assemblages. For him, women introduced the pottery traditions which they had previously learned at their homes to the settlement of their 'husband', while traditions in flint processing were more soundly anchored at one particular location only (Strien 2000, 33).

From physical anthropological data from the mass grave at Talheim (Baden-Württemberg, DE; Wahl and König 1987), Eisenhauer (2003) proposes that the members of this group were representatives of a society in which patrilocal residence rules prevailed. Data derived from isotope studies on human bone is interpreted in a very similar way (Bentley *et al.* 2003; 2005). Based on the strontium isotope data from the cemetery at Stuttgart-Mühlhausen 'Viesenhäuser Hof' (Baden-Württemberg, DE), Knipper and Price (in press) suggest that especially in an earlier phase of the LBK a substantial proportion of women or young girls had moved to this settlement from regions with different 'isotopic signals'. In the later phases, there is less indication for migration or transhumance.

In addition to the aforementioned diachronic traditions within single farmsteads, Kolhoff (1999) has observed that on a contemporaneous level there are similarities in the main motifs of different settlements, but that these are not constant in time. Thus, taking exogamous marriage rules and their effects as given (cf. Peoples and Bailey 1994, 206; Müller 1992, 161), she is able to sketch a 'communication model' which is affected by long-lasting farmstead (i.e. residential group) traditions and, as a result of marriage alliances, by changing similarities between different farmsteads at the same time (Kolhoff 1999, 121). Her interpretation is that the learning processes within society were flexible. Accordingly, the women who 'married' and moved to their 'husbands' ' farmsteads first made pottery in their own local (home) decorative traditions and later adapted or submitted to the ornament repertoire of the female family members of their husbands; later, they passed on the resulting 'style' to their descendants.

At this point, the distinction of different elements in the decorative spectrum of LBK pottery should be pointed out. They comprise motifs at the vessel's rim; linear, ribbon-like main motifs on the vessel's body; and secondary motifs applied to the vessel walls within the angles formed by the main motifs (cf. Stehli 1973; Claßen 2007, fig. 4). The analyses discussed above (Friedrich 1994; Kolhoff 1999) obtained their results mainly from the study of the main motifs, but as early as the 1970s Petar Stehli was aware that in comparison to other motif types, secondary motifs are not as restricted by certain norms. For this reason he proposed that it should be tested whether these motifs actually represent individual or local pottery

traditions (cf. Stehli 1973, 73).

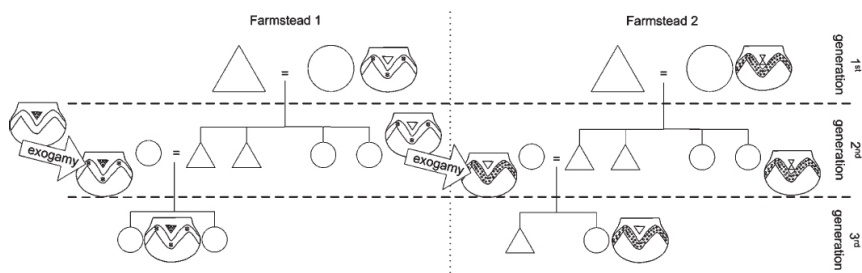


Figure 2. Simplified model of pottery traditions in the LBK in the Rhineland. Decorative traditions were passed on from the elder to the younger generation, probably in the female line. Main motifs are bound to residential (virilocal) groups, while the secondary motifs were introduced from outside by ‘married’ women as an expression of their kin ties with their home community.

Furthermore, secondary motifs are considered as indicators of communication and exchange between different groups within LBK society (Krahn 2003). This belief is based primarily on assumptions concerning how vessels were decorated and how these traditions were passed down from the older to the younger generation (see above). Thus, it is expected that ‘learning groups’ would have existed which would have been structured according to age, and that within these groups a certain ‘decoration idea’ was transmitted. For this reason, Krahn (2006, 303, note 107) suggests that these motifs may be symbols containing evidence for group identity. In order to trace the transfer of an ‘idea’, Krahn (2003) examined the distribution of secondary motifs at the farmsteads of the main settlement Langweiler 8 (Boelicke *et al.* 1988). Her results can be summarised as follows: a connection between the secondary motifs and a vessel’s function could not be discerned. Due to the great variety of the motifs, specialised pottery production is unlikely. The secondary motifs do not reflect the traditions of single farmsteads; it seems more likely that their variety is connected with the influence of the individual potter. Finally, some of the motifs were in use for up to 250 years. For this reason, it can be concluded that they were not mere ornaments but symbols with a codified meaning.

In expanding the described model after Kolhoff (1999), the secondary motifs can be seen as symbols which reflect the ‘decoration idea’ propagated by the group where the potter originally learned her craft. Due to the fact that specialisation in pottery production is unlikely, and that there are only few traditions on single farmsteads in time, it is most likely that similarities in the secondary motifs are kinship based, while the main motifs reflect the tradition of the residential group (Figure 2).

In my PhD thesis, methods taken from social network analysis were applied to describe and analyse the social relations between LBK settlements. Based on the data for the stone artefact inventories and the secondary motif inventories of 28 well examined sites, the exchange and communication networks which existed in the early Neolithic Rhineland were reconstructed. Based on the research

summarised above, the similarities in the secondary motifs are seen as symbols indicating kinship ties between different farmsteads, and the exchange of flint raw material is seen as being representative of economic relationships. Before summing up the results from my own studies, a short introduction into the basic concepts and methods of social network analysis seems advisable.

Social Network Analysis – concepts and methods

The term ‘social network analysis’ does not describe a single method of analysis, but a group of methods which find application particularly in the social and behavioural sciences, as well as in cultural anthropology. The substantial components of networks are actors (i.e. persons or groups of persons) and their relations. Besides this, certain properties of actors and relations may represent components of network analyses.

The network perspective focuses on relationships among social entities. The methods of social network analysis provide formal statements about social properties and processes, and the aim is to discover and display the social structure of a given network. The explanation of the determined structure is the next step of research. Empirical objects of investigation using this structural analysis may be, for example, communication and exchange between social entities, participation in rituals or diffusion of innovations in a region, i.e. aspects of human behaviour which can be extrapolated from archaeological data. Particularly the research on exchange relations is of interest to archaeologists (cf. Görlich 1989; Hunt 1988; Schweizer and White 1998).

Comprehensive summaries of ‘the research history’ of social networks is given by Scott (1991, 7–38) and Schweizer (1996, 13–21), but due to the fact that social network analysis is inherently an interdisciplinary approach, it proves rather difficult to formulate a homogenous ‘story’. Therefore, here I will only mention some of the main aspects from an anthropological point of view.

As a supplement and criticism to Radcliffe-Brown’s (1952) structural functionalism, the network approach was developed within the so-called ‘Manchester group’ of British anthropology (Barnes, Bott, Gluckman, Mitchell and Nadel). Research conducted by Barnes (1954) and Mitchell (1969) shaped the term of a social network as “a specific set of linkages among a defined set of persons, with the additional property that the characteristics of these linkages as a whole may be used to interpret the social behaviour of these persons involved” (Mitchell 1969, 2). In the opinion of these authors, social network analysis was particularly suitable for the investigation of weakly institutionalised social relations.

However, turning away from structural functionalism towards more symbolically oriented research, cultural anthropology in the 1970s experienced a paradigm shift, which also saw the analysis of social relations and social organisation patterns ‘go out of fashion’. Nevertheless, outside the field of cultural anthropology, the theoretical foundations of structural functionalism (Radcliffe-Brown 1952; Nadel 1957) and the network approaches of the ‘Manchester group’ (Barnes 1954; Bott 1971; Mitchell 1969) were incorporated into different fields, such as sociology, social psychology, communication science, statistics and computer sciences. These very diverse influences culminated in an interdisciplinary, internationally-oriented research field whose exponents are

convinced “that social network analysis is far more than an intuitively appealing vocabulary, metaphor, or set of images for discussing social, behavioural, political or economic relationships. Social network analysis provides a precise way to define important social concepts, a theoretical alternative to the assumption of independent actors, and a framework for testing theories about structured social relationships. The methods of network analysis provide explicit formal statements and measures of social structural properties that might otherwise be defined only in metaphorical terms” (Wassermann and Faust 1994, 17).

Some of the fundamental concepts, measures and factors in the analysis of social networks are as follows (cf. Wasserman and Faust 1994, 17–21, 28–59; Claßen 2008, fig. 1):

‘Actors’ are discrete individual, corporate, or collective social units.

Actors are linked to one another by social ‘ties’.

Any subset of actors, and all ties among them, are defined as a ‘subgroup’. Their properties are a major concern of social network analysis.

‘Groups’ are the collections of all actors whose ties are to be measured.

The collection of ties of a specific kind connecting members of a group is termed a ‘relation’.

Finally, a ‘social network’ consists of a finite set of actors and the relation or relations defined between them. The crucial aspect of a social network is the presence of relational data.

The most common type of network is a ‘one-mode’ network. This means that all actors belong to one set, e.g. students at a university. In keeping with this example, information flow between students and professors can be quantified and measured. This type of network is called a ‘two-mode’ network, because it contains two different sets of actors. Furthermore, keeping the measurement of relations and the analytical methods in mind, we have to distinguish between ‘directional’ or ‘non-directional’ relations, and between ‘dichotomous’ and ‘valued’ relations.

Relational data can be recorded in ‘matrices’ or as ‘graphs’. In the so called ‘sociomatrix’ of a one-mode network, the actors are listed in the rows and in the columns. The presence or absence of a non-directional, dichotomous relation is coded in the cells by either 1 or 0. In the graph – or ‘sociogram’ – the actors are displayed by nodes, conjoined by lines representing the relational tie. Should the relation be directional, then the tie is shown as an arrow. This said, it becomes clear that graph theory and matrix-algebra are important for the mathematical analysis of networks (cf. Wasserman and Faust 1994, 67–166). The following paragraphs introduce only those network properties which are of interest to the analysis of LBK settlements.⁸

One of the primary concerns in social network analysis is the identification of the most important actors in a network. Importance or prominence of an actor can be described by different ‘centrality’ values. The focus of a network or group on a small number of actors leads to a measurable ‘centralisation’ of the whole network. When dealing with prominence, the following aspects are important (Schweizer 1996, 190): to what extent does the activity of single actors differ; how autonomous are the actors; and which potential do the actors have in controlling information flow within the network?

Activity, autonomy and control can be measured on the basis of different

characteristic values. These values are 'degree', 'closeness' and 'betweenness', which can be applied to both actors and networks (cf. Claßen 2008, fig. 2).

'Degree centrality' measures all direct relations between individual actors, and in doing so indicates the extent of their activity. The more relational ties one actor shares with other actors, then the higher the degree of centrality will be. 'Degree centralisation' is a measure that quantifies the variability of the individual actor indices. If the actors' degree values are equal, then the degree centralisation of the network is low (0). If one actor is conjoined by ties with all others, but these are not interconnected, then the degree centralisation index is 1.

Concerning 'closeness', it is important to mention that indirect relations are also measured. The closer one actor is to all others, the more effective and autonomous the actor's position is within the network. 'Closeness centralisation' is an index for the entire network. A high value signifies that a small number of actors are connected on direct paths, whilst the others are only joined indirectly.

'Betweenness' also looks at the indirect relations, but focuses on the likelihood that any given actors might control relational ties. The value for 'betweenness centralisation' of a network is high when just one or a small number of actors control relations. The centrality measures are usually standardised to the size of the whole network and expressed as percentage values. For a more comprehensive review of further methods used in the analysis of prominence in networks, see Wasserman and Faust (1994, 169–219).

The measures thus far introduced have aimed at analysing hierarchy and power within networks. A further analytical approach concentrates on 'cohesive subgroups' within networks. "Cohesive subgroups are subsets of actors among whom there are relatively strong, direct, intense, frequent, or positive ties" (Wasserman and Faust 1994, 249). One way of distinguishing subgroups is via the analysis of cliques (cf. Claßen 2008, fig. 3). "A clique in a graph is a maximal complete subgraph of three or more nodes" (Wasserman and Faust 1994, 254). This means that in a part of the graph, all possible lines between the nodes are present. When nodes belong to more than one clique, the role of the actors concerned is of particular interest. The methods used to search for cohesive subgroups try "to formalize the intuitive and theoretical notion of social group using social network properties" (Wasserman and Faust 1994, 249).

Social Network Analysis – case study

In the following, I will refer to the analyses of prominence measures and cliques of early Neolithic settlements in the Rhineland. However, it should be emphasised that a critical factor in these analyses is always the relational data. While sociologists or cultural anthropologists obtain relational data through interviews or observations, we as archaeologists derive relational information from similarities in the archaeological record.

In my example – the exchange and communication networks of the LBK – contemporaneous settlements or farmsteads are regarded as actors. The relational ties considered are, on the one hand, similarities in pottery decoration, indicative of dichotomous, non-directional relationships which may be interpreted as reflecting kinship ties, and on the other hand the exchange of flint raw material, which can be understood as directional and valued relationships and interpreted

from an economic viewpoint.

The basis for the network analyses presented here are 28 well examined settlements, marked by triangles in Figure 1. For one main settlement (Boelicke *et al.* 1988) it was possible to regard individual farmsteads as actors, as this site was completely excavated and spatio-temporal units could be defined to a very high resolution. However, this is much more difficult if only a random part of a settlement has been subject to excavation, as is for instance the case with the sites near Königshoven. In order to incorporate these settlements into the analyses, a rather coarse chronological division of the LBK period into three phases proved essential: older (HG I–VII), middle (HG VIII–X) and late LBK (HG XI–XIV). This distinction made it possible to highlight changes in the relationships between settlements in the course of the LBK. Consequently, this does not allow tracing connections between settlements from generation to generation, although it is still possible to describe principal structures and changes. All network analyses were carried out using the UCINET 6 software package (Borgatti *et al.* 2002).

The analysis of raw material exchange involved principal component analyses (cf. Doran and Hodson 1975) of different features of the stone artefact inventories. The resulting main components for all three phases reflect the production intensity of a certain raw material and the dependency on this material (flint from the sources near Rijckholt near Maastricht, NL; cf. Figure 1). In this way it is possible to bring the analysed settlements into a sequence, with producers and distributors of a certain material at the one end, and settlements receiving half-finished products and tools at the other (cf. Claßen 2008, fig. 5). In network analytical terms, we can describe this as an asymmetrical network, in which the material is always distributed from settlements with higher production intensity to those where less production waste is found.

For the further interpretation of the network data from the three phases, the factors settlement duration, settlement type and geographical position were also considered. Briefly, the network analyses on the raw material distribution system yielded the following results:

No changes can be observed in the general direction of the distribution. This means that during the entire 350 years of occupation, those settlements closer to the raw material sources near Rijckholt show a greater intensity of production and were in the position to distribute blanks.

When taking a closer look at the Lower Rhine Basin, we have to distinguish between different settlement groups on the Aldenhovener Platte in the southwest, and those on the Titzer Platte in the northeast. The measurements of centrality for the settlements in these regions show that only main settlements and a few neighbouring single farmsteads were main distributors of raw material within the research area. However, the centralisation of the network is low in all three phases, which means that none of the distributors had a powerful position within the exchange network. Thus, the potential for conflicts can be regarded as having been low. In two settlement groups, larger settlements changed their position as main producers and distributors within the system between the middle and the later LBK phase. Therefore, rights or duties connected with the exchange of raw material were rather stable for about 200 years, after which a change becomes visible.

The data base for the network analyses of pottery ornaments, which may be

interpreted as symbols indicative of traditions and group identity within LBK society, includes all decorated vessels from well examined LBK sites dated to the three phases defined above. In the datasets – actor-by-actor matrices – the cells indicate whether two settlements or farmsteads share secondary motifs.

As an example, Table 1 shows the degree, closeness, and betweenness centrality of settlements in the younger LBK. The identification of cliques within the LBK networks results in tables like Table 2. In the following, however, results from these analyses are summarised without discussing such tables and values in detail.

In the older phase, a high cohesiveness in the research area is obvious. This is indicative of strong conformity and possibly even social control during this phase. Very close relations between single settlements imply that the first settlers in the northern part of the Rhineland continued traditions of farmsteads founded earlier in the Merzbach valley (Figure 3). For the middle phase of the LBK, clique analysis leads to the definition of different subgroups (Figure 3). Nevertheless, in general the relations are similar to the preceding phase: very strong ties exist between single settlements on the Aldenhovener Platte and the subgroup east of the river Rur. These very intense relations were upheld for a period of 200 years, and therefore it seems justified to assume that they reflect kinship ties. With the beginning of the latest LBK phase the network changes. The settlements well embedded in the former phases become less important. Some other settlements, marked in Figure 3 by arrows, now have a stronger influence on the decorative spectrum. Within the settlement groups, single sites seem to distance themselves from one another. This means they display no similarities in the examined secondary motifs.

Table 1. Centrality and centralisation measures of the younger LBK settlements in the Rhineland, based on similarities in secondary motifs. All analyses were carried out using the UCINET 6 software package (Borgatti et al. 2002).

<i>settlement-farmstead</i>	<i>degree [%]</i>	<i>closeness [%]</i>	<i>betweenness [%]</i>
LW02	73.9	79.3	20.5
LB07	73.9	79.3	8.3
LM02	65.2	74.2	7.1
NM04	65.2	74.2	4.0
LW09	56.5	69.7	10.7
Kö14	56.5	69.7	8.5
Kück	56.5	69.7	6.4
LW08-10	47.8	65.7	3.3
HA08	43.5	63.9	4.1
LW03	43.5	63.9	2.4
ALD3	39.1	60.5	0.8
LW08-12	34.8	60.5	0.4
LW08-7	34.8	59.0	2.8
WW29	34.8	59.0	0.3
LW08-8	30.4	56.1	0.2
WW17	26.1	56.1	0.0
Kö12	26.1	52.3	0.0
WW06	13.0	50.0	0.0
HA21	13.0	46.9	0.0
Kö13	8.7	46.9	0.0
LN03	8.7	45.1	0.0
Kö01	8.7	43.4	0.0
Kö09	4.3	45.1	0.0
LW08-9	4.3	45.1	0.0
centralisation	41.1	41.6	18

Table 2. Tables resulting from searches made for cliques among the younger LBK settlements of the Rhineland, based on similarities in secondary motifs. All analyses were carried out using the UCINET 6 software package (Borgatti et al. 2002).

<i>cliques</i>	<i>member (settlements-farmsteads)</i>						
1	Kö14	Kück	LB07	LM02	LW02	LW03	NM04
2	Kö14	Kück	LB07	LM02	LW02	LW08-10	NM04
3	ALD3	Kück	LB07	LM02	LW02	LW08-8	NM04
4	HA08	LB07	LM02	LW02	LW03	LW08-7	NM04
5	HA08	LB07	LM02	LW02	LW08-10	NM04	
6	Kö14	LB07	LM02	LW02	LW03	LW08-7	NM04
7	ALD3	LB07	LM02	LW02	LW08-12	NM04	
8	Kö14	LB07	LM02	LW02	LW08-12	NM04	
9	HA08	LB07	LW02	LW08-10	LW09	NM04	WW29
10	Kö14	Kück	LB07	LW02	LW08-10	LW09	NM04
11	ALD3	LB07	LW02	LW08-12	LW09	NM04	
12	Kö14	LB07	LW02	LW08-12	LW09	NM04	
13	LB07	LW02	LW08-12	LW09	NM04	WW29	
14	ALD3	Kück	LB07	LW02	LW09	NM04	
15	HA08	LB07	LW02	LW03	NM04	WW29	
16	Kö14	Kück	LB07	LM02	LW02	LW08-10	WW17
17	ALD3	Kö12	Kück	LB07	LM02	LW08-8	NM04
18	Kö14	LB07	LW09	WW06			
19	HA21	LM02	LW03				
20	HA21	LM02	LW08-10				
21	Kö01	Kö14	LW08-7				
22	Kö13	Kück	LW09				
23	HA08	LN03	LW09				

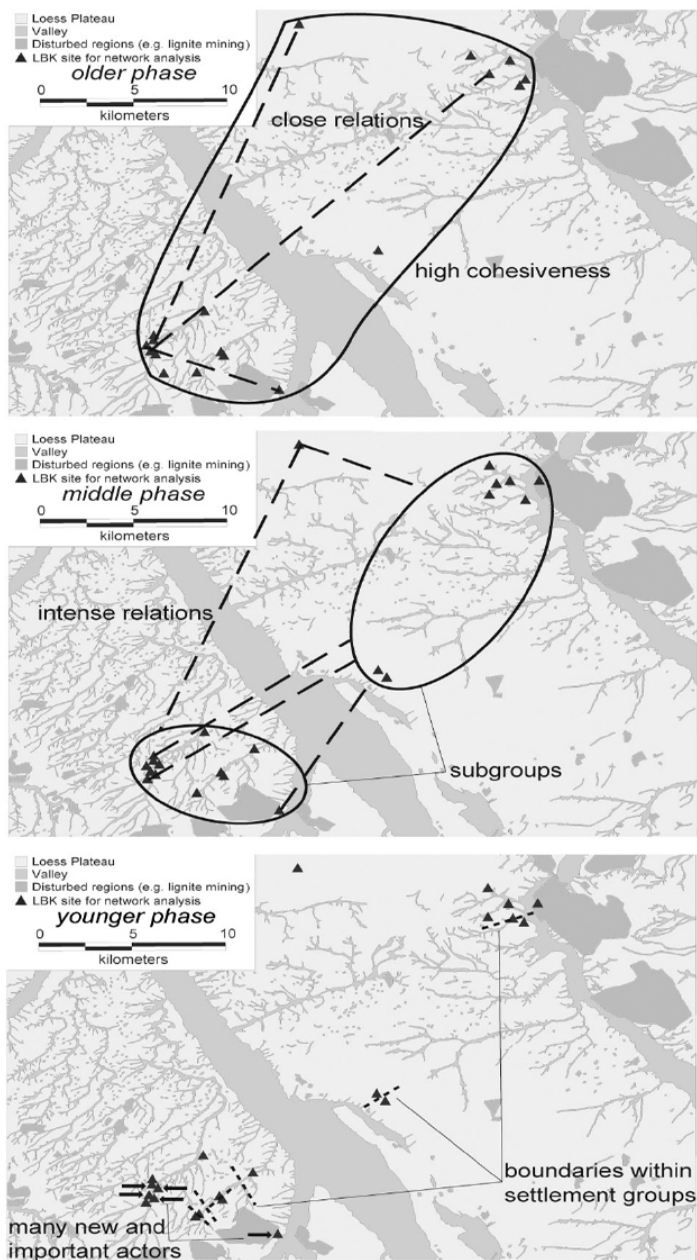


Figure 3. Three maps of the research area summarising the results of network analyses undertaken for the stone tool inventories and for the similarities in pottery decoration for three phases of the LBK in the Rhineland.

In summary, it can be stated that during the earlier phases of the LBK, the observed relations have a causal connection with the settlement history of the distinct settlement groups. Settlements founded earlier are obviously better embedded than later settlements. Therefore, kinship relations are seen as being responsible for similarities in pottery decoration. In the later phase, new actors became important as producers and distributors of flint raw material. Furthermore, at this point in time boundaries between exactly these settlements can be observed with reference to pottery decoration.

This change is interpreted as a breakdown in long lasting kinship ties. Fridrich (1994) has referred to this as the “emancipation of the younger generation”. Settlements in neighbouring regions separated from one another, which is also implied by the construction of enclosures at the end of the LBK. This – as well as the reduction of long distance contacts in the later phase – supports strongly the opinion that social units were much smaller in the last generations of the LBK.

The structures which were responsible for the very stable social system of the older and middle LBK begin to change as early as a century prior to the end of the LBK in the Rhineland. Therefore – in my opinion – the disappearance of the typical LBK features in the Rhineland is very much the result of processes related to social change.

Acknowledgements

I wish to thank Penny Bickle and Daniela Hofmann for accepting my paper for this book. I have presented new methodological approaches and some new results, but I have to admit that this paper is firmly rooted in well-established traditions of LBK research in western Germany. This paper has also summarised the (partially unpublished) work of many other colleagues and I feel indebted to their thorough research and hope that I am capable of expressing their results in an adequate manner. For support, discussions and critique I am grateful to numerous colleagues at the Universities of Cologne and Frankfurt, as well as from the Monuments Council responsible for the sites examined (Rheinisches Amt für Bodendenkmalpflege). In the course of the last ten years, my research has been supported financially by both a six months grant (for my M.A. thesis) and a three year grant (for my PhD thesis) from the Stiftung zur Förderung der Archäologie im Rheinischen Braunkohlenrevier, as well as a two year grant from the University of Cologne. I would like to express my most sincere thanks to both institutions.

Notes

Here, ‘Rhineland’ is understood as the southernmost part of the Lower Rhine Area. This region, which in geographical terms is known as the Cologne Basin (Ger. Kölner Bucht or Niederrheinische Bucht), is bordered by the low mountain ranges of the high fens (Ger. Hohes Venn) and the Eifel in the west, and the Bergisches Land in the east. This region between the cities of Bonn, Aachen and Düsseldorf is, in contrast to the lowlands that follow in the north, characterised mainly by fertile loess soils, which were ideal for the first farmers. Due to the focus of LBK research on the lignite exploitation areas west of Cologne, when talking about the LBK in the Rhineland I mostly refer to the ca. 900 km² large region between Aachen, Köln and Mönchengladbach.

In this text, the German terms Linearbandkeramik and Bandkeramik or the abbreviation LBK are preferred to the English term Linear Pottery.

3Settlement Archaeology of the Aldenhovener Platte in the Rhineland' (SAP).

4Landscape Archaeology of the Neolithic in the Rhineland lignite mining area'; the project was financed by the Stiftung zur Förderung der Archäologie im Rheinischen Braunkohlenrevier and the DFG.

5The focus here is on the Rhineland. However, as research in Bavaria has shown, these models are also appropriate to define the spatial and temporal development of LBK settlements in other regions (cf. Herren 2003).

6Synonymously, I also use the term household, which rather stresses the aspect of a yard as a socio-economic unit.

7In contrast to Lüning (1997b, 43), the term settlement group (Ger. Siedlungsgruppe) is here preferred to that of a 'settlement alliance' (Ger. Siedlungsverband), as the relatedness of the settlements inherent in the definition of the latter is difficult to prove with archaeological data. Therefore, geographical agglomerations of sites are here referred to as settlements groups (cf. Lüning 1997b, 42).

8Within the scope of this paper, it does not seem advisable to go into the theoretical and methodological details of social network analysis. For the interested reader, I would recommend as a starting point Wassermann and Faust (1994) and the volume edited by Carrington *et al.* (2005).

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First reflections on the exploitation of animals in Villeneuve-Saint-Germain society at the end of the early Neolithic in the Paris Basin (France)

Lisandre Bedault

Introduction

Defined in the early 1980s, the early Neolithic Villeneuve-Saint-Germain (VSG) cultural group belongs to the Danubian Neolithic tradition, since its material culture and settlement type resemble the Paris Basin late Bandkeramik (RRBP). Faunal remains have provided a first general view of animal resources in the subsistence economy. With the development of research projects and numerous rescue excavations (particularly from 2000 onwards), much new information on fauna has gradually been accumulated. While this has revealed a certain variation in herd composition, the data remain scattered and convincing explanations have yet to be found. A new study of all the available faunal data from VSG settlements offers a different view of the stock-keeping practised by these populations. This paper is based on a Masters thesis (Bedault 2005) which analysed the animal bone assemblage from the Villeneuve-Saint-Germain culture. The objective here is to present a critical synthesis of our knowledge of the VSG faunal remains.

New evidence has highlighted a certain variation in the composition of livestock herds, but up till now the data has been scattered and has not really been successfully explained. The last synthesis of faunal remains dates to the middle of the 1990s and was based on the three sites then known in the Oise valley (Arbogast 1995a).

Although the corpus of evidence established for the present study has been made as complete as possible, the relevance of each faunal sample for a discussion of the subsistence economy must be taken into consideration. It has therefore been necessary to evaluate the quality of all the available samples.

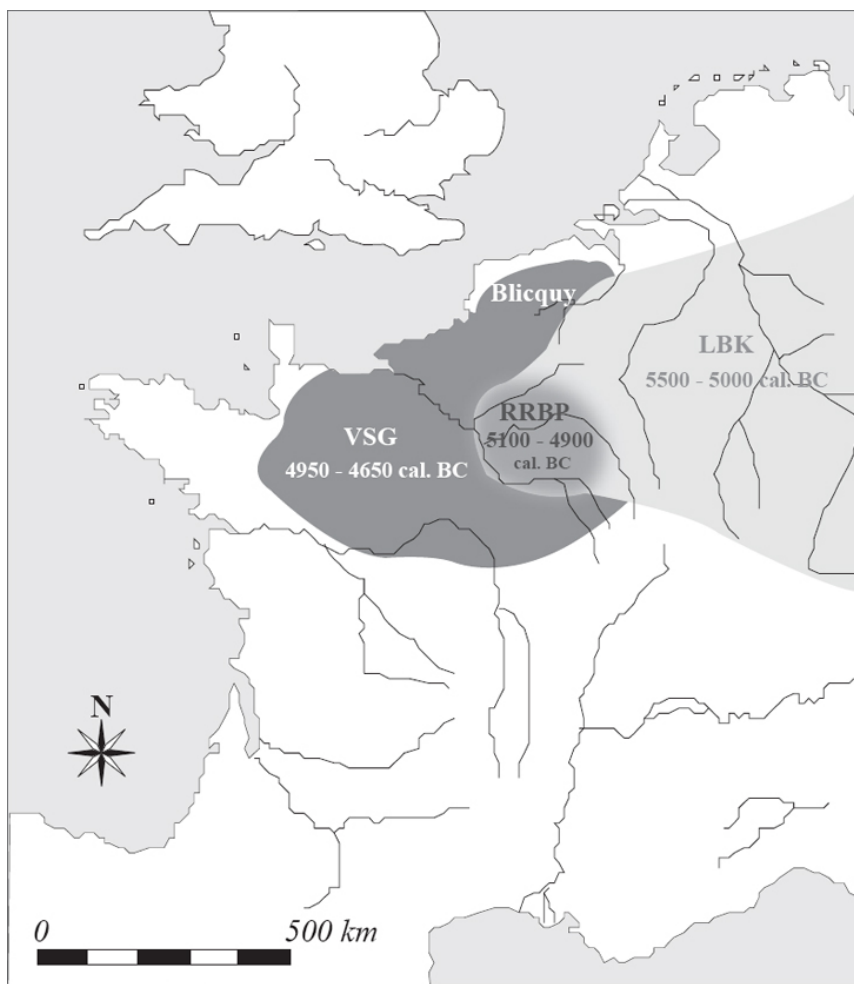
The chronological and cultural framework

The Linearbandkeramik (LBK) culture first appears in France in Alsace and Lorraine, in the early stage (*Rubané ancien*). The Paris Basin sequence starts in the middle stage, with the *Rubané moyen champenois*. This is followed by the *Rubané*

récent champenois and then by the *Rubané récent du Bassin parisien* (RRBP). The Villeneuve-Saint-Germain (VSG) group emerges in the Paris Basin at the end of the RRBP. Defined at the beginning of the 1980s (Constantin and Demoule 1982), the VSG is closely related to the Blicquy group in Belgium (Caspar *et al.* 1989; Burnez-Lanotte *et al.* 2001) (Figure 1), and is broadly contemporary with the Grossgartach group in Alsace.

The chronological sequence was established from ceramic decoration (Constantin 1985; 1998; Lanchon 1984; Ilett 1989) and lithic data (Augereau 1993; Bostyn 1994; Allard 2005). This conclusion is also based on recent research programs and is consolidated by the analysis of C¹⁴ dates carried out by Dubouloz (2003). It is this chronology that forms the framework for this study, even if some authors today consider the VSG to be contemporary, or even earlier, than the RRBP (Jeunesse 1998; Lefranc 2007). So in the present study, I consider the RRBP to date to 5100–4900 cal BC and the VSG-Blicquy to 4950–4650 cal BC, thus overlapping about fifty years with the RRBP. The middle Neolithic in the Paris Basin begins with the Cerny culture between 4700 and 4300 cal BC (Demoule *et al.* 2007).

The geographical extent of the VSG is quite large. It is essentially concentrated in the northeast of the Paris Basin, but it has also been found in the Massif Armoricaire (Cassen *et al.* 1998; 1999; Marchand *et al.* 2006; Pailler *et al.* 2008), Basse-Normandie (Billard 2002; Clément-Sauleau *et al.* 2002), Haute-Normandie (Bostyn 2003; Riche 2004), Maine and Anjou (Chancerel *et al.* 1995; Verron 2000) and finally, recently it has been found in the Bassin de la Loire (Cassen *et al.* 1999; Poissonier 2004; Creusillet and Irribarria 2006; 2008).



LBK : Linearbandkeramik

RRPB : *Rubané Récent du Bassin Parisien* (Paris Basin late Bandkeramik)

VSG - Blicquy : Villeneuve-Saint-Germain - Blicquy

Figure 1. Simplified map of the early Neolithic cultural groups in France.

Taking into account the most recent data, around 100 VSG sites are currently known. Although the VSG follows the Danubian Neolithic tradition by its similarity to the RRPB material culture, it distinguishes itself through a number of unique characteristics. The VSG settlements are found on the valley bottoms, but also on the plateau edges. The same types of longhouses are found, with lateral pits (Figure 2), but house plans are consistently trapezoidal in form (Constantin and Demoule 1982; Coudart 1993; 1998).

Four stages have been defined from the ceramic and lithic material. In brief, the early VSG stage sees the appearance of a new ceramic decorative style; the herringbone (*arêtes de poisson*) design covering the whole of the pot surface, which lasts until the middle stage. At the end of the VSG, we see frequent use of applied cordons (*cordons en relief*) and V decoration above the handles (Constantin 1985; Lanchon 1984; 2008). Also, the influence of the Rhine basin can be noted in the decorative patterns (Meunier 1999; 2003). Among the lithic tools, tranchets and long blades, together with schist bracelets, are characteristic of the VSG (Augereau 1993; Bostyn 1994; Fromont 2006; Fromont *et al.* forthcoming). Finally, some burials have been excavated, but their number remains very low for the whole culture (Gambau 1997; Thevenet pers. comm.).

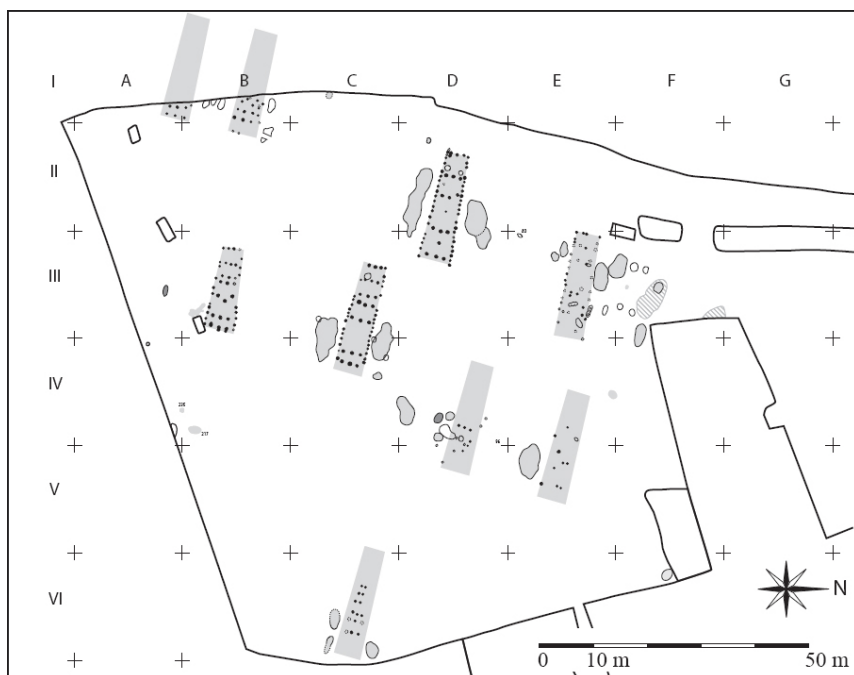


Figure 2. Plan of the settlement at Vignely 'La Porte aux Bergers' (Lanchon 2006; in press).

Research problems

Many recent studies have been carried out on the faunal remains of the VSG, essentially by Arbogast (1995a) and Tresset (1996), but no synthesis has been attempted for the whole corpus of VSG faunal assemblages from the Paris Basin. Nevertheless, some recurring observations can be noted, which have allowed the conclusions discussed below to be reached.

In temperate Europe, at a large majority of the Danubian Neolithic sites, LBK and post-LBK, animal husbandry represents the principal animal exploitation strategy (93%). In fact, even though wild animals were not an insignificant part of

the meat economy, hunting tends to decrease, reaching a level below 10% (Hachem 1999; 2001a). This decrease in the level of hunting has already been observed in the RRBp sequence and generally continues in this manner during the VSG. However, it must be stressed that differences in the frequency of wild fauna also exist between sites and that this phenomenon is found in each period (Arbogast *et al.* 2001; Hachem 2005).

In the Paris Basin (Figure 3), cattle are systematically in the majority amongst the domestic animals, accounting for more than half the sample at each site. It is commonly held that the secondary meat resource was caprines during the RRBp and domestic pig during the VSG. However, this generalisation of the data is not valid, as there is a certain degree of variability in the strategies used to exploit domestic animals within the same cultural group (Arbogast 2001; Hachem 2003). Indeed, in the LBK period in Alsace and Champagne, caprines and pigs are equally represented at the sites of Rosheim *Sablière Helmbacher*, Dachstein *Am Geist* (Poulain 1979), Bischoffsheim *le Village* (Arbogast 1990), Colmar *Route de Rouffach*, Orconte *les Noues* and Juvigny *les Grands Traquiers* (Arbogast 1994). Furthermore, certain VSG sites, such as Pontpoint *le Fond de Rambourg* (Arbogast 2002), Changis-sur-Marne *les Pétreaux* (Hachem 2002a) or even Poses *sur la Mare* (Hachem 2003) demonstrate a higher proportion of caprines than domestic pigs. As far as the large wild mammals hunted in the VSG are concerned, red deer and aurochs continue to be important both in the Paris Basin and in Alsace (Arbogast 1993a). Again, however, variations have been observed at Longueil-Sainte-Marie *la Butte de Rhuis III* (Arbogast 1995a) and at Tinqueux *la Haubette* (Bedault 2004), where wild boar is dominant. It is also at these two sites that domestic pigs are more frequent than elsewhere during the VSG. A similar association of wild boar with domestic pig has also been observed at the RRBp site of Cuiry-lès-Chaudardes (Hachem 1995; 2001a).

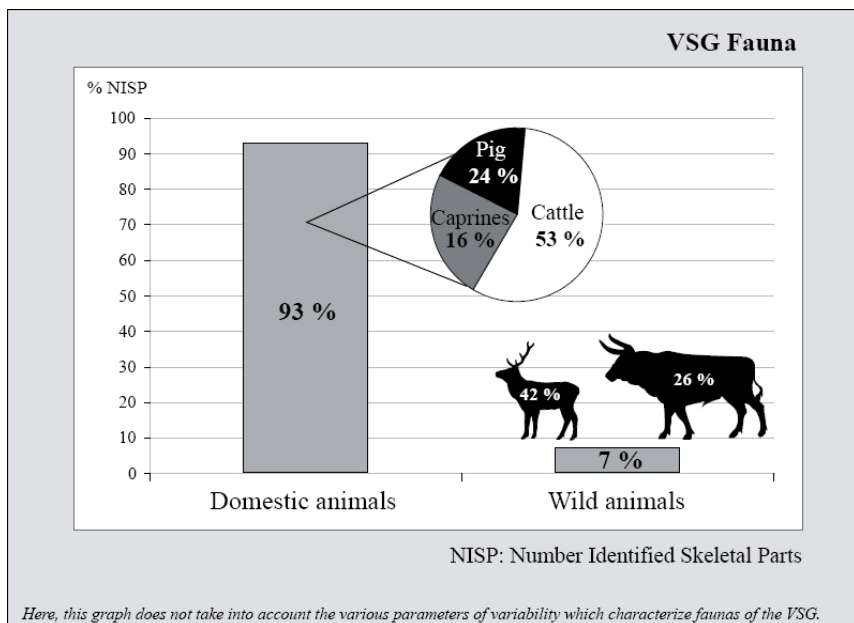


Figure 3. Relative frequencies of species, based on all data from VSG sites. The variability is presented in Figure 6.

Small game, such as fox, badger and hare, which are often used for fur and occasionally for their meat, are poorly represented. The role of fish is still little known and underestimated because of the absence of systematic sieving during excavations. However, four VSG sites did produce significant quantities of fish remains: *Fresnes-sur-Marne les Sablons*, *Bucy-le-Long la Fosse Tounise* (Aisne), *Longueil-Sainte-Marie la Butte de Rhuis III* (Oise) and *Trosly Breuil les Obeaux* (Oise). Recent and current studies carried out by Clavel and Arbogast (2007) have highlighted the preferential consumption of carp, bream and roach.

Thus the results and conclusions of the different studies carried out to date now show that the exploitation of domestic and wild animals remains difficult to comprehend. We only know that there is a certain diversity in the faunal assemblage between one site and another. It is, therefore, from these observations that we seek to understand the origin of the variation in livestock composition within the VSG culture. In order to achieve this, it was necessary to produce an inventory of the available faunal records from the whole cultural group. On the basis of this inventory, I will discuss how representative the samples are and thus establish what the different interpretations of VSG economy and subsistence are based on. Consequently, I will try to provide a more accurate picture of husbandry during the VSG early Neolithic.

Several origins of this variation are possible and they are most likely to be linked to one another. However, despite this, I will try to discuss them separately. Three approaches will be used: ecological, chronological and socio-economic:

1. The ecological requirements of animals could be one of the possible reasons for

the different compositions of the observed faunal samples. Faced by the diverse ecological conditions offered by the Paris Basin and the different types of settlement location, VSG populations had in fact two alternatives. Either they could maintain herd composition and exploitation strategies unchanged, whatever the site location, or they could adapt herds and strategies to local conditions. Indeed, the presence of a plain, a river, forests and large clearings imply different food resources and conditions for moving around, which the animals may, or may not, be able to adapt to. It will thus be appropriate to compare the ecological niches of each settlement with the ecological needs for each species and the range of diversity found in the faunal assemblage.

From the same perspective, I want to verify if the geography really can account for the variability in the faunal assemblage. Indeed, in a previous work, I identified two geographical areas in the Paris Basin where some differences were observed in the representation of domestic animals (Bedault 2004). However, I now have a number of reservations about this, because although there were some geographical variations, the evidence was not representative enough to prove the significance of geography for herd composition.

2. The study of variation in VSG faunal assemblages only makes sense if it is considered alongside the contemporary culture groups (Grossgartach in Alsace and Blicquy in Belgium) and also those that are earlier (RRBP) and later (Cerny). Two questions thus emerge. Firstly, is the variation observed for the VSG exclusive to this period? In other words, do the different contemporary, earlier and later assemblages demonstrate the same variability? Secondly, can the VSG practices for acquiring meat be seen as part of a long chronological trend? Can we identify a development in the exploitation of domestic animals throughout the Neolithic? To answer these questions, it is necessary to determine if all the data are comparable before arriving at a particular conclusion.
3. The socio-economic component is the last point that I will consider in this paper. Of course, it is obvious that the elements discussed above are closely intertwined and must be accounted for when discussing this last aspect. The function and organisation of the buildings may provide an answer to this variability. However, this discussion is limited because we know very little about the organisation of the houses and the organisation of the villages. If the reason can be explained as simply 'practical', dependant on the food economy, we can indeed consider how a particular species could have provided more to the community than others (amount of meat, level of reproduction). Finally, there could be a cultural reason, which is not easily expressed through the concrete data available to us (archaeological remains, statistical data from bones, etc.).

The faunal assemblage

The VSG faunal assemblage is almost exclusively known from the rescue excavations that have been carried out over the last few years. The organisation of rescue archaeology in France has led to a tendency to adopt a regional view of the VSG. Thus, in five of the principal regions of the Paris Basin, different research programs leading to the discovery of new sets of faunal remains have been developed (see appendix). As a result of this, there is a great heterogeneity in studies of the faunal samples: finished studies, studies in progress, simple mention

of fauna, counts of fauna, absence of precise description, etc. Also, for the same type of study, the methods of analysis vary. Firstly, there is a problem associated with how the faunal remains are counted. In certain cases, the bones have been only classed as vertebrates (mammals, birds, fish) or as sub-groups of ruminants (artiodactyles), and are not counted in the number of identified remains (NISP). Therefore, in bringing the separate data sets together, I have chosen to integrate the different determinations of the NISP in my study. I have also removed deer antler from the NISP, because only antler of slaughtered red deer can indicate hunting and in some cases, there were no such indications. It should be noted, however, that the inclusion or not of antlers makes a clear difference in the numbers of deer represented in the faunal record. Finally, the minimum number of individuals (MNI) is not always calculated. Occasionally this is justified by the small number of faunal remains, but this is not always the case. Thus, we cannot rely entirely on these methods of calculation when discussing the questions posed here (e.g. validity of the samples, notions of breeding and herding; Bedault and Hachem 2008). It is also necessary to consider that we are comparing sites of different natures, from a group of more or less complex houses to simple isolated features such as pits. Consequently, sample representativity is likely to vary. Indeed, in cases where the NISP exceeds 800 (800 is the average for the samples), ten assemblages come from domestic sites where the house plans are more or less preserved, whereas the others either come from possible lateral pits where the association with a longhouse is uncertain, or from isolated pits. Finally, the comparative analysis undertaken here will be limited, as some geographical regions are under-represented. There are multiple reasons for this: the history of research (there are only three VSG sites with faunal remains in Normandy and only one in the Champagne region), or the different rates of bone preservation. There is poor preservation in Normandy and Belgium due to the loess soil.

Below are descriptions of the faunal assemblages for nine geographical regions of the Paris Basin (Figure 4):

1. In the Aisne valley, nine VSG sites have been recorded. Those producing faunal remains (six sites) have already been the subject of a thesis finished in 1996 (Bolen 1996), but there were a number of miscalculations. A revised study of the data is currently in progress by the author. It includes the following sites: Villeneuve-Saint-Germain *les Grandes Grèves*, Bucy-le-long *la Fosse Tounise*, Bucy-le-long *le Grand Marais*, Bucy-le-long *la Fosselle* (building n°20, transition final stage of RRBp/early stage of VSG), Berry-au-Bac *le Chemin de la Pêcherie*.
2. In the lower Marne valley, a joint project currently underway (Lanchon 2005a; 2005b; 2006) has recorded about twenty sites, nine of which have a more or less abundant faunal assemblage. All of these samples have been studied, except one which is still currently in progress: Fresnes-sur-Marne *les Sablons* (Arbogast pers. comm.), Mareuil-les-Meaux *les Vignolles* (Arbogast and Shaeffer pers. comm.), Changis-sur-Marne *les Pétreaux* (transition final stage of RRBp / early stage of VSG; Hachem 2002a), Chelles ZAC *des Tuileries* (Bedault 2005), Neuilly-sur-Marne *la Haute-Île* (Hachem 2004), Jablines *les Longues Raies* (Arbogast 1993b), Vignely *la Porte aux Bergers* and Luzancy *le Pré aux Bateaux* (Bedault 2006b). The study of the faunal remains from Jablines *la Pente de Croupeton* (Hachem 1986–1987; 1991) is in progress. The samples from the Marne valley represent the largest corpus of faunal remains from the VSG, both in terms of

quantity and quality.

3. In the upper Seine valley, at its confluence with the river Yonne, about ten VSG sites with faunal material are known. About half have already been studied (Tresset 1993; 1996; 1997a), the others are currently being investigated by the author in the course of a PhD thesis. The sites are: Marolles-sur-Seine *le Chemin de Sens* and *les Prés-Hauts*, Barbey *le Buisson Rond* and *le Chemin de Montéreau* (Tresset 2000), Etigny *le Brassot Est* (Carré 2004), La Saulsotte *les Grèves de Frécule* (Bedault 2005), Villeneuve-la-Guyard *Prépoux*, Passy *la Sablonnière*, Gurgy *les Grands Champs* and *les Plantes du Monts*.
4. In the Oise valley, the last synthesis of the faunal remains, published in the mid-1990s (Arbogast 1995a), included the three sites already known: La Croix-Saint-Ouen *le Pré des Îles*, Longeuil-Sainte-Marie *la butte de Rhuis I* and *la butte de Rhuis III*. Since then, Longeuil *le Barrage* (study currently underway by Arbogast) and Pontpoint *le Fond du Rambourg* (Arbogast *et al.* 1998; Arbogast 2002) have been excavated. Recently the site of Maurecourt *la Croix de Choisy* has been extensively excavated (Durand 2006), and the faunal remains studied by Bellimi (2007). These sites all provided faunal assemblages of variable abundance.
5. In the lower Seine valley (*département de l'Eure*), Poses *sur la Mare* (Bostyn 2003) and the recently discovered Aubevoye *la Chartreuse* (Riche 2004; Riche and Ravon 2006) are the only sites to have produced faunal remains in the region of Normandy due to the acidity of the soils, which poorly preserves bone.

In the peripheral zones to the east (Champagne) and west (Loire and lower Normandy) of the VSG culture, faunal remains are almost absent on domestic sites. For example, only about ten fragments of bone were found at the sites of Beaufort-en-Vallée *le Boulerot* (Poissonnier 2004) and Colombelle *le Lazzarro* (Billard 2002). Finally, in Belgium only two Blicquy sites have produced faunal remains, but in very small quantities due to poor preservation in the loess: Vaux-et-Borset *la Croix de Marie-Jeanne* and Vaux-et-Borset *Gribour* (Hachem 2001b). Furthermore, Grossgartach sites in Alsace, contemporary with the VSG, have produced very few faunal remains: Lingolsheim *les Sablières Modernes* (Hachem 1997), Dachstein (Poulain 1979), Colmar *Rue de Balzac* and Wettolsheim *Ricoh* (Arbogast 1994).

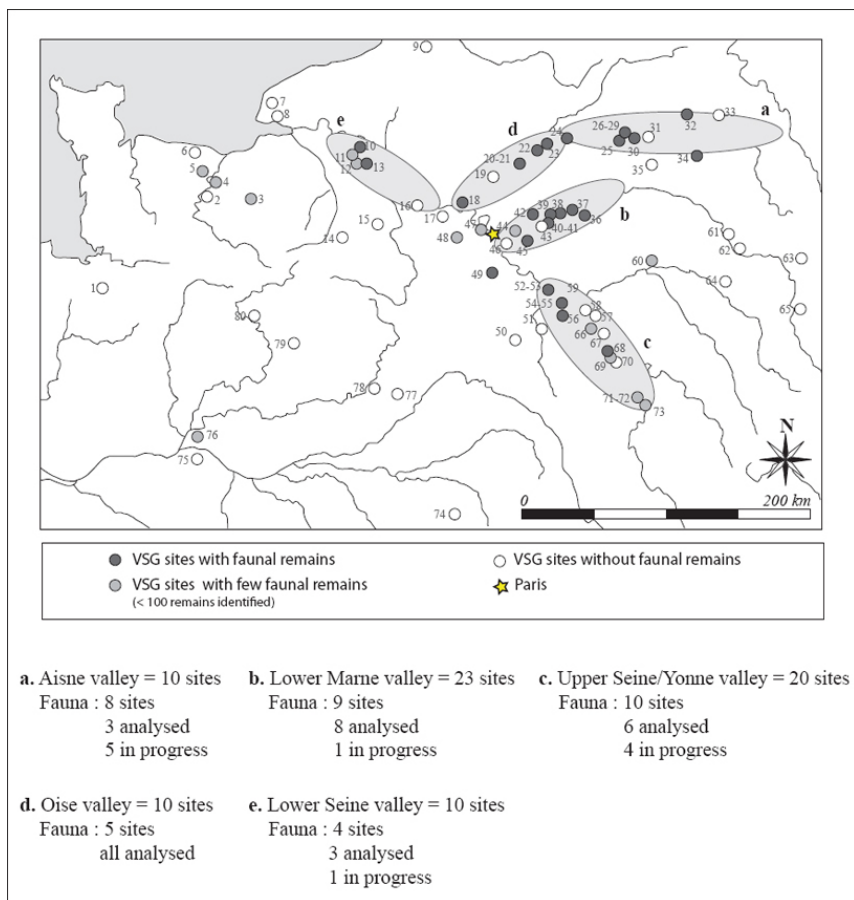


Figure 4. Location of VSG sites in the Paris Basin and corpus representativity (see Appendix).

In total there are 44 VSG sites with faunal assemblages. Among these, nine sites have a NISP of less than 100 and 17 have a NISP equal or greater than 800. As a comparison, of the 193 early Neolithic sites in central and western Europe with faunal remains, the Paris Basin accounts for almost half of the samples (Figure 5). Therefore, this study can be considered to benefit from a relatively good representation in comparison to other parts of Europe.

The analysis

We can now focus on the various factors likely to influence the relative frequency of various animals in faunal remains, which are most probably linked to one another: the environment, the chronology and socio-economic practices. It must be noted that our current knowledge obviously depends on the state of research.

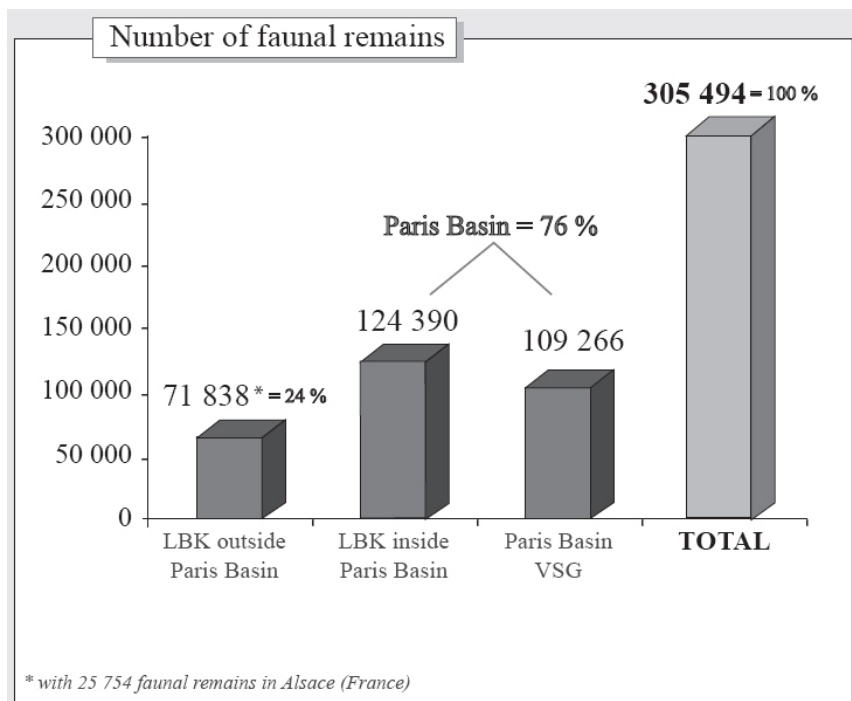


Figure 5. Quantitative data for fauna within and outside the Paris Basin, in number of remains.

The ecological factor

The immediate environmental background of the animals, as well as their nutritional, reproductive and social needs, are an important part of any study. Here, I will investigate the necessary conditions for an animal to thrive. This is one of the first considerations which come to mind, because it is “the ecological niche which governs the presence or absence, and the abundance, of each species in the given ecosystem” (Vigne 1991, 442). Thus, Vigne (1991, 446, fig. 2) and Tresset (1996) created a table in which they summarised the “probable ecological requirements of the prehistoric forms of the four large groups of European domestic artiodactyles” (Vigne 1991, fig. 2, 446; Tresset 1996). During the Neolithic period, and with the effects of domestication, the animals were not subjected to natural constraints because they were protected by humans and could therefore adapt to different biotopes (Bogucki 1982; Digard 1990). However, during the VSG, the techniques of domestication had already been mastered and the communities had learnt enough to free themselves from a number of environmental constraints. Pig is a good example. Wild boar, the ancestor of the domesticated pig, principally live in forests and coppices, but are occasionally found in meadows and fallow land, as illustrated by Vigne’s table (1991, 446, fig. 2). Their diet is therefore varied and they can survive in a wide range of environments. Domesticated pig would occupy the same ecological niches if they

were free to roam. However, according to the authors (Vigne 1991; Tresset 1996), it seems that pigs were kept in pens from the Neolithic, showing that this species could thrive within a very restricted space. Moreover, its omnivorous character allowed Neolithic groups to feed it their rubbish (Bökönyi 1974). If this was the case, the environment would only have a limited impact on domestic pigs. Moreover, we know little of the types of food and environments available for this animal during the Neolithic. It is necessary to combine our archaeozoological studies with environmental data (palynological, carpological, data from isotopic analysis) (Balasse and Ambroze 2005; Le Bras-Goude *et al.* 2006).

Now I will explain the variation in the domestic animal remains by examining the correlation between the topography of the sites and the composition of the assemblages. Rubané villages were only built on the valley floors, and during the VSG both the valleys and the plateau were settled. Does this change in settlement pattern correspond to a varied exploitation of animal resources in the VSG? At the moment it is impossible to answer this, because on the plateau sites faunal remains are only partially preserved, such as at Chelles (Seine-et-Marne) (Meunier 2005).

Some studies have sought to establish regional variation in the different species found in the faunal assemblages (Döhle 1993; Tresset 1996; Arbogast and Jeunesse 1996; Vigne and Tresset 2001). Tresset (1993; 1996; 2000) has perceived regional differences during the VSG between the assemblages from the Seine-Yonne confluence and those found in the north of the Paris Basin, notably in the Aisne and Oise valleys. This difference is also underlined by Meunier (2003, 98) on the basis of the VSG ceramic decorations, where “strong regional components depend on the various currents of influences and probably on specific social dynamics”. In a previous study, I too looked for differences between the west and east of the Paris Basin, where groups contemporary to the VSG from the Rhine influenced the composition of VSG livestock (Bedault 2004). I had indeed seen a dichotomy between, on the one hand, the sites of the south of the Paris Basin and those of the north and, on the other hand, the sites of the west of the Paris Basin and those of the east. But these results hardly seem more convincing, considering I focussed only on the sites of Barbey *le Chemin de Montereau* (Seine/Yonne confluence) and Poses *sur la Mare* (Lower Seine valley) to justify my arguments. In this paper, I would like to reconsider these reflections and examine whether variations observed between the faunal assemblages can be explained through the geographical distribution of the sites. Therefore, I have attempted to define potential geographical territories for VSG settlement: Oise valley, Aisne valley, Vesle valley, Marne valley, Upper Seine and Yonne valleys, and finally the Lower Seine valley.

Thus, from the division of the region by valley we could perhaps begin to see a geographical difference in the composition of domestic animal assemblages. First of all, in the valley of the Aisne and its tributary the Vesle, as well as in the Oise valley, pig is more frequently present. The Marne, Seine and Yonne have similar proportions of caprines and pig. The Lower Seine only offers two sites, where caprines were hardly better represented for the moment (excavation in progress). However, when the detail is considered, each geographical group is very heterogeneous. Not only does each geographical group consist of a low number of representative sites, but moreover the vision which one has of a geographical region can be completely changed according to whether one takes into account

particular sites. Furthermore, it proves that future discoveries are most likely to modify the models presented here. Lastly, even though the geographical divisions of the region under study here can appear to be arbitrary, no logical pattern can be observed regardless of the distribution. Therefore the geographical divisions do not explain variations in the faunal assemblages within the VSG.

Chronological variability

What is the place of the VSG groups in the transition from the early to the middle Neolithic? How does the VSG compare to the earlier, contemporary and later groups?

The Rubané

The Linearbandkeramik (hereafter Rubané) appears relatively early in Alsace and is divided into four stages (early, middle, late and final). The sites in Alsace have been studied by Poulain (1979) and by Arbogast (1994; 2001) who integrated these sites into a synthesis of the region. The data from this region are not numerous because the areas excavated on most sites are quite small. From the early and middle Rubané in Alsace, six sites are available for study. The three best known are Dachstein (Schneider 1980; 1985), Colmar (Jeunesse 1987) and Ensisheim (Arbogast and Jeunesse 1990). In the Upper and Lower Alsace regions, cattle are dominant (between 35% and slightly more than 60%), a domination which becomes even more marked in the RRBP and VSG (around 70%). However, for the Alsace region, there are some particularities which relate to the secondary faunal resource. Thus, according to Arbogast (Arbogast and Jeunesse 1996), in Lower Alsace the secondary resource is domestic pig, while in Upper Alsace this place is held by caprines. During the late and final Rubané, a gradual homogenisation of the exploitation of domestic pig is envisaged for Alsace, to the detriment of caprines, as well as a reduction in the frequency of cattle. However, it should be noted that if the percentages published are taken into account (Arbogast and Jeunesse 1996) exceptions do exist; sometimes sheep (they make up more than 40% of the assemblage at Ensisheim *Ratfeld* and Dachstein *Am Geist*) and sometimes domestic pigs (38% on the site of Rosheim *Sainte-Odile*) dominate. Thus, the variability that we have already mentioned for the VSG is perceptible since the early and middle Rubané in Alsace. Moreover, this trend is similar, as it affects the secondary faunal resource as well.

The middle and late Rubané stages are also present in the Champagne region. Three sites are available for consideration: Larzicourt, Orconte *les Noues* and Juvigny *les Grands Traquiers*. In spite of good preservation of bones, the faunal assemblages are small. These middle and late Rubané sites from the Champagne region illustrate the problems of representativity of the sample sets. These samples do not seem sufficient to establish a particular model for the food economy (Arbogast 1994; Arbogast and Jeunesse 1996), since there are no clear differences in the frequency of pig and caprines. The assemblage from the site of Orconte consists of 7.5% domesticated pig and 11.4% sheep, with these percentages corresponding respectively to 12 and 18 identified bones. At Juvigny, both species represent a little more than 4% of the assemblage and no more than two individuals were counted for each species. The samples from Larzicourt are still unpublished. However, at Juvigny, the percentage of wild animals is fairly high

(30%; wild animal NISP = 307). This trend is equally perceptible during the following period, the RRBp, at the sites of Cuiry-lès-Chaudardes (Hachem 2001a) and Pont-Sainte-Maxence (Alix *et al.* 1997).

Finally, for the faunal remains of the RRBp, contemporary with the final Rubané of Alsace, studied by Hachem (1999; 2001a), the data are numerous. This is the result of a long-term research program in the Aisne valley, which began in the 70s (Ilett and Hachem 2001). Caprines are clearly the secondary resource after cattle, because the proportion of domestic pigs is radically smaller. Furthermore, recent studies have shown that at the very end of the RRBp, caprines were even more strongly present, exceeding in certain cases cattle (Bedault and Hachem 2008). An increase in the percentage of caprine remains is observable in the RRBp on the sites of Berry-au-Bac *Le Chemin de la Pêcherie* and *Vieux Tordoir*, Menneville *Derrière le Village*, Missy-sur-Marne *Le Culot* and Cuiry-lès-Chaudardes *Les Fontinettes* (Hachem 2005; Bedault and Hachem 2008).

The VSG

It would be interesting, as suggested above, to study the faunal assemblages of each VSG settlement at the household scale, but this is not possible for all the sites. Thus, the discussion here will take into account the VSG sites whose chronological stages (early, middle, late or final) could be determined (Lanchon 2008) and those for which it was possible to clearly distinguish two stages. Generally, we can see the early VSG stage as a continuation of the final RRBp (Figure 6), due to the dominance of caprines (nearly 30%) over domestic pig, whereas from the beginning of the middle VSG their relative frequency is reversed. It is domestic pig (25%) which becomes the second resource after cattle and this tendency continues right up to the Iron Age (Auxiette and Hachem 2007). It seems that the exploitation of caprines was gradually replaced by that of pig through time.

The example of the VSG sites from the Marne valley provides a good illustration of the goals and limitations of the approach adopted in my research. As mentioned above, nine sites with faunal assemblages are known (Figure 7). From a general point of view, for the whole valley, the hypothesis of chronological evolution in the composition of domestic herds is apparently valid, with a dominance of caprines in an early VSG stage and a dominance of domestic pig from the middle stage onwards (Figure 8). However, when one looks at this on a settlement by settlement basis, for the early stage house 90 at Vignely does not follow this pattern, whereas on the site of Changis the livestock of the houses demonstrates a dominance of caprines. For the middle VSG, Vignely again stands out with house 150, whereas domestic pig is in the majority at Jablines and Mareuil. At Luzancy, caprines and domestic pigs are equally represented apart from houses 3 and 4, which have an abundant faunal assemblage. During the late stage, Vignely continues to pose problems with house 10. Lastly, the final VSG stage is only represented by feature 42, which is completely dominated by pig.

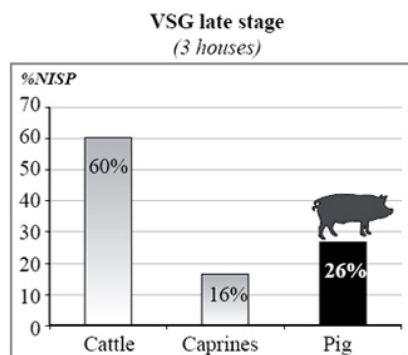
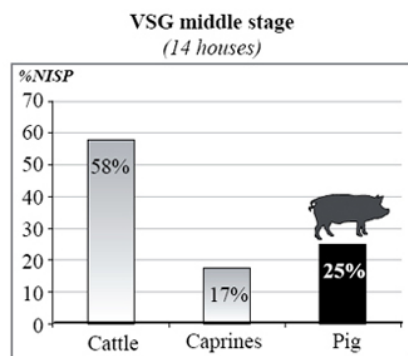
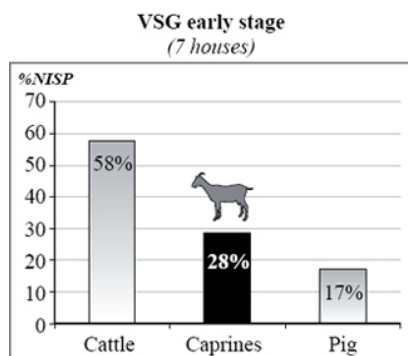
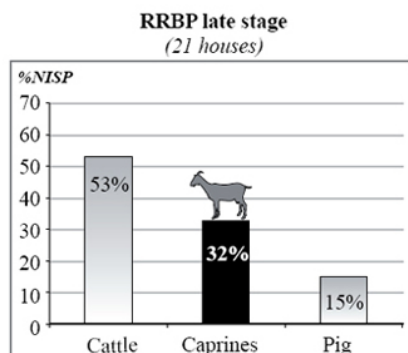
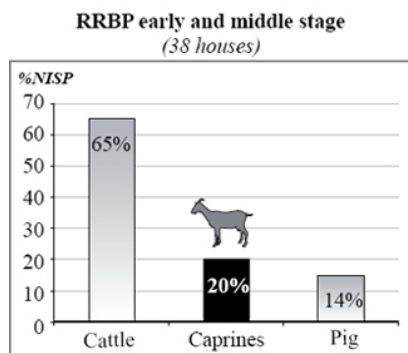
Thus in the case of the Marne valley, this model functions, but the site of Vignely seems separate. Does this signify that there were some variables which we do not understand? It should be recalled that most of the time the vision we have of these sites is partial, that is to say no VSG site has ever been completely excavated. Thus we have no information about possible differences within a village, relating for example to butchery techniques or functional and social

aspects. Thus the representativity of the material is of major concern. However, the discussion relating to chronology is only valid if it takes into account other research questions, such as the function of the buildings within a village (Bedault and Hachem 2008).

The Cerny

The sites which date to the Cerny period are not numerous (six sites) and the faunal assemblages come from a number of different types of sites: enclosures, both with interrupted and non-interrupted ditches, and lateral pits, sometimes where the presence of a house has not been proven. The six sites are Balloy *Les Réaudins*, Barbuise-Courtavant, Châtenay *Les Pâtures* (Tresset 1996; 1997b), Maisons Alfort ZAC *Alfort* (Hachem 2002b), Pont-Sainte-Maxence *Le Poirier* (Arbogast 1995b) and Conty ZAC *Dunand* (Hachem pers. comm.). Amongst this group of sites, only the enclosure site at Balloy has produced a significantly large sample of animal bones (NISP = 1647). The fauna from the Cerny period, such as it has been defined (Tresset 1997b), is essentially composed of domestic animals, with cattle forming by far the largest proportion of the remains, leaving second place to domestic pig. The presence of caprines is insignificant. However, this model is not systematically applicable, because at Pont-Sainte-Maxence caprines and pig are equally represented at 18% and at Conty, domestic pig is more frequent than cattle. In these two cases the sites are open settlements rather than enclosures, which leads Hachem (2002b) to suggest that the different functions of these sites are the cause of this variation.

Domestic animals

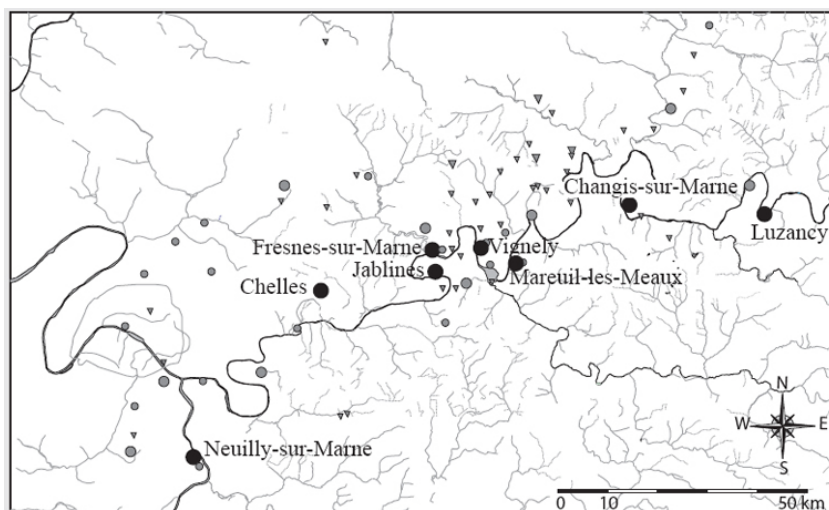


RRBP : Rubané récent du Bassin parisien
(Paris basin late Bandkeramik)

VSG : Villeneuve-Saint-Germain

NISP: Number Identified Skeletal Parts

Figure 6. Domestic animals: trends in meat consumption by chronological stage in the early Neolithic of the Paris Basin.



- settlements
- isolated pits
- ▼ surface find
- settlements with faunal remains

Sites ●	NISP	NIR	TOTAL
Neuilly-sur-Marne	427	868	1295
Chelles	62	148	200
Jablines PC *	2805	5672	8477
Jablines LR	114	815	929
Fresnes-sur-Marne **	460	1741	2201
Vignely	1874	1676	3550
Mareuil-les-Meaux **	1392	1105	2494
Changis-sur-Marne **	877	887	1764
Luzancy	1986	1810	3796

See appendix for bibliographical references on fauna

* in progress

** inedit, unpublished

NISP : Number Identified Skeletal Parts

NIR : Indetermined Number of Remains

Figure 7. Location of VSG sites in the lower Marne valley and quantitative data for fauna (map by Collective Research Project, Lanchon 2005a).

Thus the Cerny is not comparable to the VSG, because there are too few Cerny sites and they do not present the same types of variability. However, it can still be noted that after the VSG, domestic pig becomes the second meat resource.

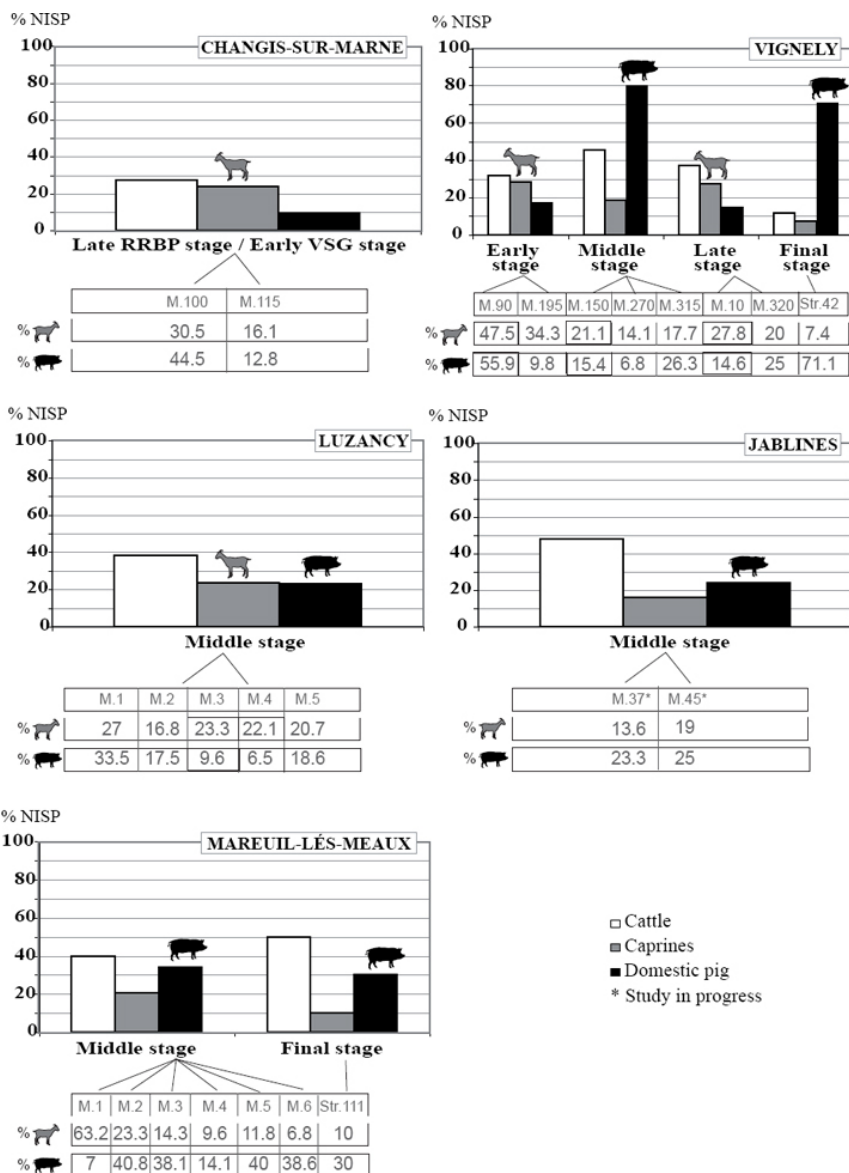


Figure 8. Domestic animals: tendencies in consumption by site in the early Neolithic of the Paris Basin.

Socio-economic aspects: first reflections

It has been suggested here that the variations observed in the VSG domestic animal assemblage had in part a chronological origin, but what were the reasons for this change? Expressed another way, why did the VSG communities suddenly prefer

pig to caprines? We have seen that this change could be linked to the disappearance of practices of the RRB culture and the first appearance of the VSG. In neglecting old practices, one would begin to adopt new ones. Does this signify that there could only be a cultural reason for this change? This is hardly a satisfying answer. Moreover, a move towards an economy favouring cattle followed by domestic pig has also been observed elsewhere (in the transition from the Rubané to Grossgartach in Alsace). It seems, therefore, that the choice was associated with domestic pig itself, or rather, with the advantages of this species. Indeed, it has been suggested that pigs were only used for their meat (with a slaughter-age of two, which corresponds to their optimal weight). In contrast to herbivores, domestic pig does not need a large area, because it can live and develop in a relatively restrained space. Furthermore, this animal offers the advantages of reproducing fast, with large litters, and needs little attention due to its diverse diet, in particular the rubbish created by humans. It provides a very interesting supplement to the contribution made to the diet by cattle. Pigs could thus have been a way of increasing the intake of meat in the diet quickly and in large quantities.

To what do we owe this search for improved productivity? Is it a need which is linked to an increase in the human population? An additional factor to take into consideration here is the wider geographical extension of the VSG in comparison to the Rubané, with the presence of sites on the Armorican Massif and along the Loire, the increase in the number of sites, the presence of flint blade production centres such as Jablines *la Pente de Croupeton* and Ocquerre *la Rocluhe* (Lanchon 2006) and exchange of raw materials over long distances (hard rock and schist). A recently published study also suggests that a rise in the population can be seen through the considerable increase in the archaeological sites from the VSG period and in the interpretation of the palaeo-demographic models developed on the basis of some Neolithic cemeteries (Bocquet-Appel and Dubouloz 2003). Although burials rarely reflect the living population (the treatment of an individual in death can vary according to different criteria, such as age, which means that we may not find all the individuals of a population), and the VSG burials are fairly poorly known, this idea of a search for improved productivity to answer the needs of an increasing human population seems attractive. An argument against this, however, would be the fact that there is no significant increase in numbers of faunal remains or in the MNI during the VSG, or in the long term, from the Rubané to the VSG.

One can in fact also pose the following question: to what extent are such changes reflected by faunal remains? There is as always the problem of how representative the samples are, as it is not always possible to calculate the MNI and we still do not know what the bone assemblages signify. Do we have a few remains from large herds or small assemblages from a few animals? Also, to appreciate whether or not the MNI calculation reflects a disproportionate importance of the remains for these settlements, it would be necessary to understand the role of the pits, how long they remained open, how they were used and the duration of occupation of both houses and villages (Hachem 1995). Finally, if an increase in the number of heads in a herd is not noted, then perhaps this suggests that the supplementary needs of the population are compensated for by other elements of the diet. Is this, therefore, indicative of a diversification of the diet? There are, for example, other meat resources, such as fish, which would

have been available because the settlements are always located by a water course. Unfortunately the context of rescue excavation frequently limits data collection (e.g. the absence of sieving). Cereals could also have made a significant contribution to the diet, but here there are problems with preservation, sampling and interpretation.

Conclusions

This first synthesis of current knowledge of VSG faunal assemblages has enabled us to discuss the different hypotheses used to explain the composition of domestic livestock during the VSG, characterised by the dominance of cattle and the alternating presence of pig and caprines as a secondary meat resource. It has also highlighted some of the problems associated with how representative the existing samples are and their meaning in the discussion of the domestic animal economy. An understanding of the variability of these samples depends on how representative they are and how they can be interpreted.

Studies based on material culture, in particular ceramics, suggest some form of regionalisation during the VSG. The analysis of the faunal remains presented here does not confirm this hypothesis. Currently there is no evidence for a correlation between the geographical situation of the sites and the animal species exploited. Moreover, some regions have gaps in the data or the studies are still underway. In addition, the ecological context does not seem to have been a major influence on the choice of domestic animals. At this stage of animal husbandry in the Paris Basin, the communities appeared already to have freed themselves from certain environmental constraints. Thus the chronological factors enable us to partially explain the observed variation in secondary resources. With a certain continuity from the RRBP, caprines remain the second resource during the earliest stage of the VSG, but from the middle VSG stage the exploitation of pig seems to develop. A large data set is required to support this hypothesis, but the currently available evidence favours the chronological explanation. The study of material from recently excavated sites (Maurecourt, Aubevoye etc.) will enable us to test this hypothesis. The development of the preferential consumption of domestic pig can be explained by the search for improved meat productivity and as a complement to cattle meat. One could suggest that these changes are due to human population increase, although current data are insufficient to confirm this hypothesis. Finally, there are other avenues of research which could be explored to help us understand the faunal remains found in the lateral pits beside houses:

- village layout, or, in other words, the organisation of the houses within the village and their spatial and status positions
- potential resources in the landscape close to the settlements, necessary for the upkeep of domestic animals
- social aspects, as reflected for example by the deposition of cattle skulls in certain features.

Translation by P. Bickle and S. Girard-Suard.

Acknowledgements

I am profoundly grateful to Lamys Hachem and Marion Lichardus, who agreed to supervise my work, for their helpful suggestions. I would particularly like to thank the ACR research team from the lower Marne valley for allowing me to use unpublished VSG site plans. I thank warmly Penny Bickle and Sterenn Girard-Suard for the translation of this paper into English, as well as Michael Ilett for his constant encouragement.

Appendix

Database of all known VSG sites containing faunal remains. The numbers (3–76) correspond to the map, Figure 4.

References of information/State of research

3. ~~Bréval 1969~~
Simple mention of fauna
4. ~~Comber 1985~~ *Port Saint-Martin*
Simple mention of fauna
5. ~~Richard 1992~~ *Le Portzaro*
Study in progress
10. ~~Bohégryn 2003~~ *Mare*
Study completed
11. ~~Vicary 1974~~ *Port*
Simple mention of fauna
12. ~~Philippe 1994~~ *Port-de-Reuil*
Counts of fauna
13. ~~Angelier 2005~~ *Chortreuse*
Study in progress
18. ~~Blanc 2007~~ *Le Port de Choisy*
Study in progress
20. ~~Bohégryn 1995~~ *Site-Marie la Butte de Rhuis II*
Study completed
21. ~~Bohégryn 1995~~ *Site-Marie la Butte de Rhuis III*
Study completed
22. ~~Bohégryn 1998~~ *Le Port de Rhuis*
Study completed
23. ~~Bohégryn 1995~~ *Ouen le Pré-des-Îles*
Study completed
24. ~~Bohégryn 1992~~ *Les Obeaux*
Study completed
25. ~~Bohégryn 1995~~ *Saint-Germain les Grandes Grèves*
Study in progress
26. ~~Bohégryn 1995~~ *La Fosse Tounise*
Study in progress
27. ~~Bohégryn 1995~~ *Le Fond du Petit Marais*
Study in progress
28. ~~Bohégryn 1995~~ *Le Fond du Grand Marais*
Study in progress
29. ~~Bohégryn 2005~~ *Am Foch (house 20)*
Study completed
30. ~~Bohégryn 1995~~ *Ainé le Culot*
Study in progress

- 32Mortier 1995 la Pêcherie
Study completed
- 34Bisquit 2004 Zette
Study completed
- 36Bédard 2000 (DB) Pétaux
Study completed
- 37Bédard 2002 Mont (DB) Pétaux
Study completed
- 38Bédard 2002 Mont (DB) Pétaux
Study completed
- 39Bédard 2000 (DB) Pétaux
Study completed
- 40Bédard 2000 (DB) Pétaux
Study in progress
- 41Bédard 2000 (DB) Pétaux
Study completed
- 42Bédard 2000 (DB) Pétaux
Study completed
- 44Bédard 2000 (DB) Pétaux
Study completed
- 45Bédard 2000 (DB) Pétaux
Study completed
- 47Bédard 2000 (DB) Pétaux
Study completed
- 48Bédard 2000 (DB) Pétaux
Study completed
- 49Bédard 2000 (DB) Pétaux
Study completed
- 52Bédard 2000 (DB) Pétaux
No precise description
- 53Bédard 2000 (DB) Pétaux
No precise description
- 54Bédard 2000 (DB) Pétaux
Study completed
- 55Bédard 2000 (DB) Pétaux
No precise description
- 56Bédard 2000 (DB) Pétaux
Study completed
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- 66Bédard 2000 (DB) Pétaux
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- 68Bédard 2000 (DB) Pétaux
Study completed
- 71Bédard 2000 (DB) Pétaux
Study completed
- 72Bédard 2000 (DB) Pétaux
Study completed
- 73Bédard 2000 (DB) Pétaux
Study in progress
- 76Bédard 2000 (DB) Pétaux
Faunal remains not studied

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Scene by the brook: early Neolithic landscape perspectives in the Paris Basin

Penny Bickle

Introduction

The early Neolithic or *Rubané Récent du Bassin parisien* (RRBP) settlements of the Paris Basin provide us with a rich and varied collection of remains. The villages of longhouses are overwhelmingly set into wooded river valleys, occupying a zone that would have been the boundary between a denser woodland and open flood plain (Bogucki 1988; Gronenborn 1999; Ilett *et al.* 1982; Whittle 1996). However, as our ecological understanding of this landscape is gradually becoming more refined (Bakels 1995; Bernard 1998; Chartier 1991; Leroyer 1997), there has been little rapprochement between the powerful understandings of the place of houses, animal bones, ceramics, lithics and human burials in the lives of RRBP communities, and their wider landscapes. Thus, while invaluable research has been carried out on the social aspects of the houses (Coudart 1998), the animal bones (Hachem 1995; 2000; Sidéra 2000), the ceramic assemblages (Constantin 1985), the lithics (Allard 1997) and burials (Jeunesse 1997), the place of the RRBP communities within their landscapes remains a missing part of the archaeological discussion.

The challenge of landscape archaeology is not only to study what falls between the sites on distribution maps, but also to consider the practices and routines which brought past peoples into their landscapes. This is, of course, to ask questions of past communities and their experiences in their physical and social worlds, rather than of the material remains themselves. The thinking of the phenomenological philosophers has been extremely influential on the practice of exploring prehistoric landscapes (Cummings and Whittle 2004; Edmonds 1999; Tilley 1994; 2004; Thomas 1996). The insight provided by this work has allowed archaeology to realise that people and their on-going daily engagement (whether social, with the environment or with material objects) cannot be separated into categories of *natural* and *cultural*, *physical* and *social*, *routine* and *ceremony* (Ingold 2000; Tilley, 1994; Thomas 1996; 2004). The aim of archaeological landscape studies, specifically those informed by a phenomenological approach, is thus not to explore the role of the natural world in which a community lives, but rather to examine the conditions of engagement with the landscape to better explore situated experiences in the past.

This does not mean, however, that the phenomenological approach is without limitations. While it can inform a general attitude to landscape, phenomenology does not provide a methodology. Thus, as Tilley (2004, 1) states, 'phenomenology is a style or manner of thought rather than a set of doctrines, rules or procedures that may be followed'. Phenomenology does not therefore prescribe the questions that we should ask of the past. It also posits that the natural sciences are not the only way of understanding the world, without discrediting the valuable discoveries made through these subjects. In order to expand the archaeology of the early Neolithic landscape of the Paris Basin, I will take a phenomenological perspective as a starting point, but will develop narratives around the reconstruction of the physical environment and the tasks that framed people's engagement with the landscape. Thus, this paper will move from a general understanding of people's engagement in the world to the *specific* performances in the early Neolithic landscapes of the Paris Basin. The performances or tasks discussed, hunting and herding, will challenge the orthodoxy that early Neolithic landscapes were merely a resource to be exploited.

What it was like: considering the environmental evidence

Human communities do not live apart from the ecological landscapes they inhabit, but can both manipulate and be influenced by the environments they dwell within (Evans and O'Connor 1999; Ingold 2000). The landscape settings of past peoples should not therefore be treated as less valuable to the archaeologist than their material remains. In general, the Linearbandkeramik (LBK) – of which the RRBP is the Paris Basin variant – and related communities showed a preference for fertile river valleys, predominantly choosing to settle on loess soils, and thus were obviously knowledgeable about their physical environments (Whittle 1996, 160; 2003). While Neolithic perceptions of the landscape may have differed widely from our own attitudes, reconstructing the physical geography of the Paris Basin can help us to understand the ecological contexts within which the early Neolithic way of life was carried out. The period we are interested in here dates to around the turn of the 5th millennium cal BC.

The main river courses that are the focus for early Neolithic settlement in the Paris Basin create the dominant features of this landscape. The rivers and the floodplains would have provided a highly seasonal, dynamic landscape, with regular flooding (Brown 1997). The plateaux between the main river valleys, in contrast, may have been wetter and more heavily wooded (Bakels 1995; Howell 1983). The early Neolithic sites of the RRBP were built on the gravel terraces adjacent to the floodplain (Ilett *et al.* 1982; Ilett and Plateaux 1995). Therefore the settlement pattern of the early Neolithic was focussed on areas of fertile soil near to the main water courses of the region. Bakels (1995) investigated two pollen cores from the Aisne valley of the Paris Basin. The main evidence points to dense deciduous forest, predominately elm, oak and hazel existing during the late Mesolithic and early Neolithic (Bakels 1995; Chartier 1991; Leroyer 1997, 106). The cores show a variety of different episodes of clearing, possibly relating to forest fires, though these need not have had anthropogenic origins (Bakels 1995).

The development of alder within the pollen diagrams comes towards the end of the Neolithic and coincides with an increase in ash, which is a light demanding

tree (Bakels 1995; Chartier 1991; Leroyer 1997). This leads Bakels (1995) to suggest that any major opening up of the landscape occurred after the period under discussion here. Bakels (1995) emphasises that the two pollen cores from the Aisne valley show contrasts in the timings of changes in vegetation and differences in the distribution of types and species of plant, demonstrating that the pollen diagrams can only really show local conditions. However, recent work by Vera (2000, chapter 3) challenges an image of dense central European forests during the Neolithic. Vera (2000, 88–95) argues that large mammals, such as aurochs and red deer, would have limited the flowering of wild grasses due to grazing, thus causing them to be under-represented in the pollen diagrams. Hence, our interpretations of these prehistoric landscapes would favour woodland and may not represent the extent to which the Paris Basin had areas of open grassland or meadow.

Sorrel is a particularly important indicator of open grassland (Vera 2000, 88) and is present in Bakels' (1995) pollen diagrams from the Aisne valley. Vera (2000) also argues that large mammals would have maintained any clearings occurring naturally in the landscape through grazing, and thus supports a view of prehistoric central European landscapes in which the amount of forest present is dramatically reduced. This argument is further supported by evidence that trees within a more open canopy, at the forest edge for instance, may have produced more pollen than a tree within a densely packed forest (Janssen 1973). Vera (2000, 101) thus concludes that this landscape would have been semi-open rather than densely forested.

River valley systems are continually in flux and are very sensitive to changes in climate (Brown 1997; Pastre *et al.* 2003, 2177), and therefore not all the changes we see throughout the Neolithic may have had anthropogenic origins. Bernard (1998, 90–95) argues flooding would have had a regular impact on the regeneration of forest. This supports Howell's (1983) suggestion that settlements were placed in naturally forming clearings along the edge of the floodplains. Leroyer's (1997) study showed a clear increase in cereal pollen in northern France from the early 5th millennium BC, alongside a corresponding increase in ruderal species (plants that colonise disturbed land). This perhaps implies a more involved role for the early Neolithic communities in changing and shaping their landscape. Unfortunately there has not been enough dating to secure a more precise chronology of this sequence, but the pollen sequence at the site of Paris-Bercy suggests that these changes were underway before 4500 cal BC (Bernard 1998, 99).

It is clear that a variety of different forms of landscape made up the Paris Basin (Chartier 1991; Leroyer 1997). I would argue that open parkland co-existed with more densely forested areas. Forests are not homogenous and can offer a great deal of variation in terms of light, undergrowth and different tree species. They are seasonal places and prone to great change, indeed a great deal of effort is required to maintain forests in a stable condition (Vera 2000). As the source of a number of important resources, such as wood for houses and fuel and plants for food and animal fodder, the Neolithic forests of the Paris Basin must have undergone some degree of manipulation or management, whether or not this was intentional.

We can thus begin to build an image of what the early Neolithic landscape would have been like. The settlements were placed on the boundary between the

more open floodplains and denser woodland that was a patchwork of clearings and different species. The deciduous woodlands of this landscape would have provided a seasonally changing landscape, from which wood for houses was taken and cereals planted in clearings. We can envisage a mixture of clearing woodland and making use of the already present and naturally formed clearings. This landscape would therefore have been changing continuously, whether by the cyclical changes during the year or by the intervention of the local communities. Change in landscape should be regarded as the norm, rather than as an unusual occurrence associated with the beginning of the Neolithic. Thus, rather than LBK communities across Europe, specifically those of the RRBp in the Paris Basin, living in hard won clearings in a dense forest, they were situated within a patch-work of clearings and woodlands of different types.

From phenomenology to performance: theoretical considerations of landscape

So the question remains, how did the early Neolithic communities fit into the picture developed here of the environment and how are we to go about discussing it? As an archaeologist whose interest is primarily in the people of the past, I want to consider how they engaged with the landscape and to bring to the fore their experiences. Phenomenology has been one approach archaeologists have taken, but over recent years the usefulness of this theory in archaeology has been called into question (Brück 2005; Fleming 2005; 2006). However, many of these criticisms centre on the application of phenomenology in archaeology and not how it teaches us to attend to the world around us, and there remains much to be learnt from its original proponents. Phenomenology (as understood in archaeology) originates in a philosophical movement that wanted to explore the world as it is experienced (Cerbone 2006; Ingold 2000; Thomas 2004). It developed as a criticism of both Cartesian dualities and naturalism, that is, the idea that understanding could *only* come from objective research in the natural sciences.

It should be more widely stressed, however, that all of these philosophers saw phenomenology as a way to leading a better life (Heidegger 1962; 1993; Husserl 1991; Merleau-Ponty 1962; Sartre 1989). Phenomenology was thus seen not as an objective, impartial description but as a way of transcending the objectification of one's own identity and, to use Sartre's (1989) terms, to 'alleviate anguish'. What is important about this statement is that phenomenology was not just intended to explain people's place in the world, but as an approach to thought and action that would actively improve it. Phenomenology is not a methodology for studying the past and was never intended as such. Rather it was intended as a general concept of what it meant to be human, focussed around the notion of 'Being' (Heidegger 1962). I would thus like to draw a firm distinction between the philosophical approach which underpins archaeological phenomenology and its use in archaeology. Any critique of phenomenology must, therefore, know its enemy – the original philosophy, the individual archaeologist's interpretation of that philosophy or their application of it to the archaeological evidence.

Let us, then, turn to the third of these identified 'enemies': the application of phenomenology in archaeology. Within archaeology phenomenology is most recognisable in the dwelling perspective, best known through the work of the

anthropologist Tim Ingold (1993; 2000; 2007). The dwelling perspective seeks to bring about an understanding of human communities through how they engage with and within their world. The emphasis is on how embodied, sensual experience places humans within their landscapes, and the active perception of the landscape means they act *in* rather than *on* those landscapes. Ingold (1993; 2000) does not lay out a methodology as such, but he does argue that archaeology should have as its objective what the world means to those who live in it or, in other words, how they perceive it. He uses the example of how the Western Apache describe their reasons for story telling: they argue that their stories do not put meanings on the world, but allow the listener to place themselves in relation to specific features of the landscape and through these relations have the meaning revealed to them (Ingold 2000, 208). The dwelling perspective thus demands that archaeology attends to the past in such a way that it becomes revealed rather than reduced. It should therefore be stressed that this does not mean all people think that they dwell in such specific terms; it is a general understanding of how people bring a certain style to their daily actions and interactions.

This is perhaps best developed through Ingold's (2000) notion of the taskscape. The taskscape is, unlike phenomenological philosophy, specific to particular historical conditions. Therefore the taskscape is the values (social or otherwise) that interlock when someone engages in their daily activities. These values are 'qualitative and heterogeneous' (Ingold 2000, 195), that is, they are the moments when the specific understandings people or communities have of their place in the world and their own history come to the fore. Thus taskscape, while informed by the phenomenological approach, is not limited by it. The notion of the taskscape foregrounds the variety we find both between different communities and within those communities.

So, have these then been the aims and achievements of the phenomenological approach in archaeology? Explicit use of this philosophy in British archaeology can be found in works published over the last two decades, with the most recognisable work being Christopher Tilley's *The phenomenology of landscape* from 1994. Within this work a number of case studies are carried out which try to describe how the landscape was revealed to the author. The criticism often levelled at this work is that it privileges the experience of one white, middle-aged, Western man (Brück 1998). I do not wish to rehearse further arguments here; rather I want to explore what the work reveals about the project of phenomenology in archaeology. While the action of carrying out the research that takes place before the writing of the book is itself phenomenological, its presentation inevitably falls short. What is revealed through this work are the possibilities for one particular archaeologist to engage with different landscapes, it does not reveal the different possibilities of the Neolithic landscape itself. It is thus very difficult not to become reductive when using phenomenology in archaeology.

However, in many ways, Tilley's (1994) phenomenological engagement with the landscape does follow the methodology set out by one of the phenomenological philosophers. Husserl (1991) saw two stages to participating in or writing phenomenology. The first is an act of description, a close attention to the flow of experience. The second stage is achieved by attending to the form or structure of the experience (Husserl 1991). Heidegger (1962), who had worked closely with Husserl's philosophy, criticised this approach because, he argued, an experience

could not be isolated from the rest of daily life. Experience does not happen in isolation but as part of the flow of daily life. It is my proposal that developments in performance theory can be useful in helping us to explore how experience in the landscape fitted into quotidian experience. Performance theory encourages thought on the specific conditions in which the body forms, or rather, pre-forms, senses of identity, time and place within the contexts of everyday routines.

Performance theory is perhaps best explained by the metaphor of dancing to music. In dance the body does not have to explain the meaning of the movements, instead meanings, gestures, harmonies and dis-harmonic actions are inter-woven in a complex network (James 2003). The onus is on skilful, knowledgeable action. The dance metaphor for the movements of the everyday, like Bourdieu's (1977) notion of *habitus*, suggests that in some way these embodied actions are pre-planned and have decided outcomes. Daily life, while made up of routines, frequently does have the potential for people to play with and manoeuvre the timings of their daily routine. There is thus much variety as this daily routine is constructive both of identity and landscape.

There is a further element to performance theory that also needs to be explored, as there is a tendency to regard arguments such as these as supporting a Goffman-like (1967) approach to identity, in which identity is picked up or taken on freely. In *The presentation of self* Goffman (1959) argues that the self is only on loan from society, thus stressing that identity is itself a learnt social concept. However, this is clearly not the case, as our actions are often bound by the contexts in which the action or task is carried out. Judith Butler (1993) argues that performances in the daily routine *are* the means by which the actor comes into being. Identity is a means by which bodies are made into the world rather than performed on and represented. Engagements in such performances are not isolated incidents but rather recall and build on past events and look to anticipated events in the future. We can apply this to how we go about exploring landscape in the past; people's engagement and activities in the landscape would have come to construct their understanding of it, but these would be particular and local.

The conclusions to be drawn from this discussion are that we must focus on the contexts in which tasks were carried out, how bodies were choreographed in these activities and the role of materials in these tasks. This means examining the specific connections between bodies and materials in the spatial and temporal circumstances in which they meet and bringing to the fore the sequence in which landscape, body, animal or material is presented in quotidian routine. Thus, in order to *write* an archaeology which develops from this point of view, description of the landscape or the activities in the landscape is not enough, the account must consider the landscape and associated activities as performative, that is, as constructing experiences, which bring understandings of the world into place and make those understandings possible. These performances or understandings are, therefore, local and particular to the time at which they take place rather than general.



Figure 1. This is an example of a north European deciduous forest from the Aisne valley. Note the variations in light densities. Photo: author.

Explorations in landscape: hunting and herding

The notion of 'forest' is often taken to describe a homogenous and undifferentiated landscape. In fact, many groups around the world, both hunters and farmers, distinguish between different types and areas of forest within their landscape (Morris 1995). The immediate area around the village is a place of the everyday; a

place for gathering fire wood, playing, hiding, secret liaisons, sexual encounters, gossiping, defecating, visiting fields and gathering foods. It is a familiar landscape of well worn paths, of daily tasks and activities. The relationship between village and wider landscape may not be so clear cut. Morris (1995) argues that although the people of Malawi regard the forest as crucially important in the supply of animal meat (through wild animals), medicine, fuel, food, building materials and human fertility, their attitudes to the forest remain ambiguous. It is not only associated with women, through the daily tasks which take them into the forest, but also with men, or rather male affines, due to its fertilizing power (Morris 1995, 308). For the Mbendjele Yaka, Democratic Republic of Congo, the forest is considered to be both life giving and full of spirits, which are, in turn, both compassionate and malicious (Lewis 2002).

The discussion above argued that rather than inhabiting small clearings amongst a densely forested landscape, the early Neolithic communities lived in a landscape that was probably a mosaic of naturally formed clearings and forests of different densities (Figure 1). It is in this setting that animals were engaged with. Therefore the performances associated with animals give us a way into exploring experience and understanding of the early Neolithic landscape. The animal species of the early Neolithic are largely classified by archaeologists into two groups: wild and domestic. Following Ingold (1996), the difference between these two groups of animals may not have been understood as a simple nature versus culture opposition, rather the relationships communities had with the different animals would have been far more complex.

As the difference between hunting and herding has normally been rendered as division between domesticated and wild resources, it has continued the view that the division between the Mesolithic and Neolithic was dramatic and absolute. Furthermore, as Whittle (2003, 82) has recognised, there has been a tendency for archaeologists to be far more concerned with the economic aspects of the animal bone assemblage, despite the rich anthropological literature, which has emphasised not only the sheer variety of human societies' attitudes to animals but also their effective ability to shape how landscape, daily life and agency are experienced (Ingold 2000; Morris 1998). Animals can also be powerful symbols or metaphors of identity, an idea developed by Hachem (1995; 2000) for Cuiry-lès-Chaudardes with regard to the varying percentages of wild boar, cattle and sheep in the loam pits of different houses.

The animal bone found in the loam pits of longhouses demonstrates that both hunting and herding were practised. However, it must be noted that these assemblages are not a direct representation of the hunting and herding practices, but have been subject to certain processes of decay. This is significant, as hunted animals may have been more likely to be consumed close to the kill-site (Whittle 2003, 90). We must, therefore, be careful not to take the animal bone assemblages from the lateral pits as the direct representation of diet, herding methods or cultural/social responses to animals. This does not mean, however, that we cannot build up a picture of what people's relationships with animals were like or explore their role in everyday tasks. Thus percentages of different animals in the total assemblage must be seen as useful relative comparisons rather than as directly meaningful (i.e. as giving a record of the composition of herd size or the amount of meat consumed by the household and so on; see also Bedault this volume).

The hunting of different animals will have offered contrasting experiences of moving through the landscape. It has been suggested that red deer and aurochs preferred different types of woodland (Whittle 2003, 90). Aurochs were thought to prefer light deciduous forests and open areas (Hüster-Plogmann *et al.* 1999, 158), while red deer probably spread through various different types of woodland (Hüster-Plogmann *et al.* 1999; Steppan 1999, 169). Some of the hunting which took place may have been from specific trips into the forest and wider landscape and other incidents may have been from opportune moments while carrying out other tasks. The skills required in hunting different animals perhaps also varied, leading to certain hunters or groups becoming particularly skilled in tracking specific animals. Aurochs and wild boar may have indicated movement along the river valley, while the presence of red deer could have originated from trips onto the plateaux.

Wild boar is a nocturnal animal, most active around sunset when they feed (Runo *et al.* 1997), thus setting this species apart from other hunted animals. Hunting wild boar will have required very different skills to hunting other wild animals. They are more aggressive than red deer, though significantly smaller than aurochs. Today, in Europe, wild boars are hunted at sunset, while there is still some light and the animals give their location away through sound (Runo *et al.* 1997). The patchwork landscape would have been an important part of hunting, as clearing edges would have attracted the larger mammals such as aurochs, red deer and wild boar for feeding (Vera 2000; Mátrai *et al.* 2004). Wild boars are also opportunistic omnivores and have proved fond of cereal crops across modern Europe (Gearier and Reyer 2004). Though Europe is much more heavily populated today than in the Neolithic, and the natural habitat of wild boars is correspondingly reduced, it could be suggested that wild boar may have been similarly attracted to crops in the Neolithic. Conflict may thus have arisen between cereal growers and the wild boar.

Arbogast (2001) has demonstrated that the animal bone assemblages from the Aisne and Oise valleys demonstrate great variability in the practice of hunting; while wild boar represent 30% of the assemblage at Pont-Sainte-Maxence, they make up no more than 2% at Berry-au-Bac and about 6% at Cuiry-lès-Chaudardes. Similar patterns can also be seen throughout the Paris Basin with red deer and aurochs, with the percentage of wild animals varying between 5 and 40% (Arbogast 2001, 89). A particularly interesting contrast to note is the prevalence of wild boar at Cuiry-lès-Chaudardes, where it is the most frequently hunted wild animal, while at Berry-au-Bac it comes third to red deer and aurochs (Hachem 1995; Hachem and Auxiette 1995, 128). By no means were all hunted animals treated the same, nor each settlement's or household's involvement with hunting consistent. Tackling the landscapes of red deer and wild boar would have offered very different experiences.

Thus different members of the community probably had different experiences in the landscape. Those individuals or groups that were more successful with wild boar hunting may have favoured or emphasised the danger element of pursuing an aggressive animal. Not only was hunting an activity carried out in smaller numbers, it may also have united people from different households. The pattern at Cuiry-lès-Chaudardes is by no means the norm, with some smaller sites seeing greater homogeneity of wild animal species between the different houses (e.g.

Berry-au-Bac *Le Chemin de la Pêcherie* (Hachem and Auxiette 1995) and Pont-Sainte-Maxence (Arbogast 2001)). At larger settlements, perhaps groups from houses with particular associations may have hunted together, while at smaller settlements groups made up of individuals from different houses would have worked together.

In contrast there may have been greater similarity in the relative amounts domesticated species contributed individually to the animal bone assemblage (Arbogast 2001; Hachem 1997; Hachem and Auxiette 1995). Herding may have offered a more consistent or more common range of experiences in the landscape, by which I mean more people within the valleys would have shared similar experiences through tending and moving with cattle, sheep/goats and pigs than with hunted animals. However, even amongst these 'domestic' animals the experiences may have varied. Evidence for herding cattle is beginning to emerge from the site of Vaihingen in southwest Germany, while pigs appear to have stayed more local to the village (Bentley and Knipper 2005). The molars from three different cattle were subjected to strontium isotope analysis and each animal appeared to have experienced a different pattern and degree of movement during its life, compared to the relatively narrow range for pigs (Bentley and Knipper 2005; Knipper this volume).

Moving with animals would have been a seasonal practice, with animals generally being pastured on higher ground during the summer months (Kienlin and Valde-Nowak 2003; Halstead 2005, 45). It has been suggested that such a practice took place throughout the summer months during the later Neolithic in the Black Forest Mountains (Kienlin and Valde-Nowak 2003). Maybe herding took people away from the settlement at particular times of the year, perhaps to meet up with other groups. Animals may have been recognised as caught up in these ties and movements around the landscape (Whittle 2003). This could have been in a very immediate way (I got this cow from the specific person/group) but also in a more performative way, i.e. the landscape came to construct those relationships; it gave the impetus and potential for relationships to be established and a way to be tied into a world or communities that lay beyond the settlement on a daily basis.

Herding and hunting would thus have provided contrasting experiences of community to daily life in the settlement. The smaller groups moving through the landscape would have created a forum for different identities and ways of being to be explored. The socialities experienced during hunting and herding may have had similarities. Transhumance can be a time when the younger members of a community can learn from their elders (Evans 2003, 173); perhaps a time of sexual experimentation, a chance to escape the tighter controls of others in the community. Hunting may have offered similar experiences, a chance to escape rivalries in the village or perhaps contrastingly, the possibility to demonstrate acts of bravado which may have inflamed new disagreements or won respect. However, within each activity there would have been different movements in the landscape. Herding would have been far more seasonal, taking people further and for longer periods of time (Evans 2003). Hunting trips may have only lasted a few days.

While the hunters and herders in this scenario were not made up of different people, that is, people both hunted and herded, they would have involved different perceptions of the landscape. The hunter requires a skilled knowledge of where to look for animals and therefore an intimate knowledge of the landscape (Ingold

2000, 24). The hunter must attend to the way the animal is in the landscape (Ingold 2000, 24); therefore the landscape becomes a place of interpretation. By this, I mean that the hunter must move through the landscape attending to its every clue; he or she must learn to see the landscape from the animal's perspective. With herding, the landscape is no less active, but the engagement with it is somewhat different. The herder, too, has to attend to how the animal sees the landscape and its requirements (Ingold 2000, 73–75). However, the herders must find a way through the landscape for their herds or flocks, rather than a way to an animal. The denser woodland on the plateau may therefore have been a place of hunting; an intimate place, with small groups of people situated in the immediacy of their surroundings.

In contrast, the landscape of herding was more expansive; it brought people into their wider worlds and in this respect it was larger and more open. I do not mean that herders would have necessarily favoured more open areas. Rather, through wider-ranging movements, herding brought people into a landscape of connections and a network of exchanges, while hunting remained a local activity carried out with intimately connected people and those engaged with on a daily basis. This is significant because these experiences would have constructed senses of place and social scale. Thus the landscape may at times have been conceptually open and larger, while at others more intimate, small-scale and close. The implication of this is that social lives were lived at different scales. The variety of performances in the landscape presented the possibility for different engagements not only with landscape, but with different forms of social exchanges.

It is, therefore, interesting to relate these different socialities to the house architectures found at Cuiry-lès-Chaudardes (Figure 2). Hachem's (1995; 1997) extremely detailed study of this site has demonstrated that higher percentages of wild boar bone are particularly associated with shorter houses, while concentrations of domesticated (and therefore herded) animals are found alongside longer houses. While it is tempting to draw parallels between the smaller scales of hunting and the shortness of the houses it is associated with, this could be over-emphasised as herding cuts across all scales of daily life at Cuiry-lès-Chaudardes (Hachem 1997). However, there may have been a symbolic significance connecting certain forms of architecture to the performances or daily tasks household members were engaged in. Thus, short houses and hunting could have been combined as one particular approach to community or household dwelling, creating liaisons between particular architectural forms and different socialities. This suggestion, however, only really applies at this particular site at the moment and further research may help us to understand the obviously complex relationship between household and architectural form across the LBK.

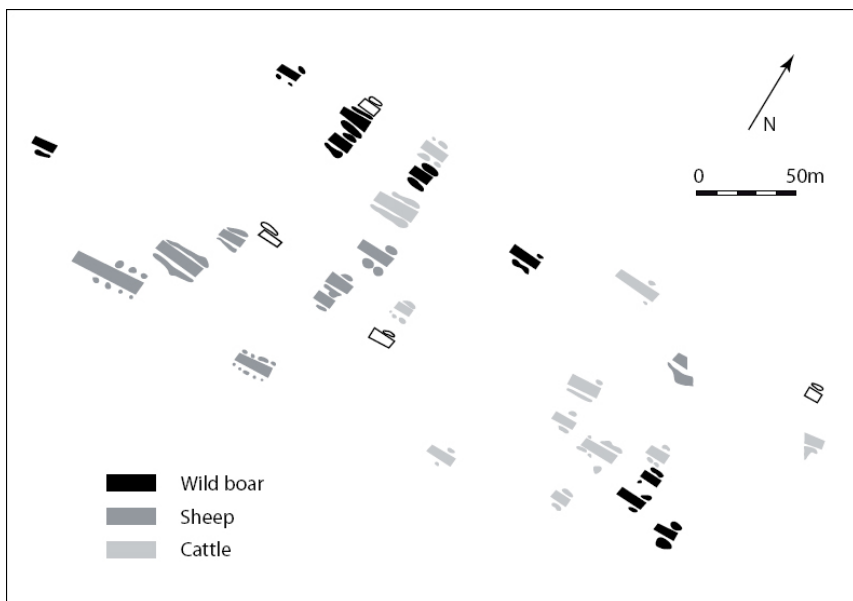


Figure 2. A plan of the longhouses from Cuiry-lès-Chaudardes, illustrating which animal species is found in the highest concentration at each house. After Hachem (1997).

Rather than RRBP or LBK individuals having static and fixed identities (such as herder of cattle or hunter of wild boar), we see that parts of the community may have selectively sought out particular experiences and therefore understandings of landscape and the wider social network. Hence, those who favoured hunting wild boar may have been seeking out the intimate, local and small-scale socialities afforded by the landscape close to the settlement more frequently than those who were focussing more on herding cattle. This does not mean that the landscape was not a place which took them into the wider ties that drew the community across the landscape; rather they deliberately approached their landscape from multiple scales and actively sought out different perceptions. The landscape was not a passive backdrop, but a fundamentally social place. It was not a place apart from the community or settlement, but a means that allowed for the creation of relationships and a way to move between the multiplicities of different scales at which people lived their lives.

Conclusion

By considering the activities which took place in the landscape, rather than how the landscape affected the groups of the early Neolithic, it has been argued here that it was a place of social importance. Those who moved with animals and hunted within it learned from the landscape and in the landscape. While hunting, the landscape would have been perceived on an intimate scale, between hunter and the animal, between the group hunting and the movement of their bodies through specific places around the valley and plateau. While herding these

experiences were also possible, but to this were added the movements which took people into a broader world, to distant less familiar groups, and perhaps fostered wider notions of community.

In this paper, the exploration of the different tasks that took people into, and across, the early Neolithic landscape of the Paris Basin has shown that people lived on a number of different social scales and illuminated some of the variety amongst these settlements. The landscape of the early Neolithic of the Paris Basin was not just an environmental constraint, restricting the adaptation and growth of the community, rather it was enabling and deeply interwoven in the socialities of the early 5th millennium cal BC. It was a place of possibility and specific engagements with the patchwork of clearings, the more open river valleys and denser wooded plateaux offering contrasting knowledges and skills for individuals and groups to explore. By focussing on the possible performances of landscape in the past, archaeologists can get closer to illuminating the material worlds in which people moved and lived.

Acknowledgements

The Charles Coles Travel Scholarship from Cardiff University allowed me to visit the Maison René-Ginouvès, Nanterre, Paris, where much of the research for this paper was carried out. Mike Ilett deserves many thanks for guiding me to many of the sources. I would also like to thank Daniela Hofmann, Caroline Pudney, Kate Waddington and Alasdair Whittle for their insightful comments on this paper. Needless to say, all mistakes are my own.

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Mobility in a sedentary society: insights from isotope analysis of LBK human and animal teeth

Corina Knipper

Mobility and sedentism in the LBK: questions for isotope research

Strontium (Sr) isotope analysis on tooth enamel has proven to be a powerful tool in the investigation of prehistoric human and animal mobility, and substantial work has already been carried out on LBK skeletal remains. Based on examples from southwest Germany, this paper explores the role of mobility among early sedentary farmers and herders and critically evaluates evidence for migrations among communities in different landscapes, upland land use, and seasonal mobility in herding practices.

Evidence of architecture is one of the major characteristics of Linearbandkeramik (LBK) archaeological remains. Numerous excavations have revealed traces of wooden posts which provide evidence for buildings like the characteristic 'long houses' that formed small hamlets or larger villages with up to several tens of contemporary buildings (Strien 2005). LBK settlement primarily concentrated on the loess-covered lowlands that were highly suitable for agricultural activities due to their very fertile, well-drained soils and easily accessible water sources (e.g. Sielmann 1971; Lüning 2000; 2005; Lüning *et al.* 2005).

Although architectural remains and crop cultivation are often assumed to be primary evidence for a largely sedentary lifestyle (Whittle 2001, 451), the role of mobility is a crucial question in early Neolithic research. Two main lines of investigation focus on either the role of migrant individuals during the establishment of the LBK, or on mobility in common economic activities, resource exploitation, and daily life. The high number of innovations at the onset of the Neolithic in large parts of Europe, which resulted in a fully agricultural economy, raised long-standing research questions about the mechanisms of the transition to agriculture. Until today, the role of migrant individuals, demic diffusion and colonisation, or the adaptation of ideas by the indigenous Mesolithic population are debated (e.g. Gronenborn 1999; 2003; Scharl 2004). These questions are hard to investigate based on material culture, because objects can be traded, stolen or carried, and ideas adapted. Therefore new cultural traits can be transmitted over

large areas without any residential changes of people (Price *et al.* 2001). Another focus of interest is mobility during the LBK and after the complete transition to an agricultural economic system. Research questions concern movements among LBK communities, integration of marginal landscapes, resource exploitation and animal husbandry beyond the core settlement areas.

During the early Neolithic, large parts of central Europe were covered by dense forests (Schweizer 2001). Villages were established on small artificial clearings (Kalis and Zimmermann 1988) and archaeologists originally envisioned agriculture and animal husbandry to have been conducted in the immediate vicinity of the settlements (Sielmann 1971; 1972). Palynological data collected since the 1980s, however, stimulated the development of alternative models (Bakels 1982; Kalis and Zimmermann 1988; Lüning 1991). They provided evidence for clearings in forest stands that cannot be entirely explained as clearings for settlements and their immediate economic area (Lüning 2000, 46) and changes in the forest composition that can be interpreted as reactions of trees to the production of leaf fodder (Kalis 1988, 130). This suggests that early farmers were active on lands outside the loess belt. In addition, calculations based on the nutritional needs of LBK villagers and their livestock, the potential annual yields of the cleared areas and the surrounding forests indicate that grazing land would have been a critical factor in a subsistence system that was entirely based on the loess lowlands and suggest that cattle herds had to be brought to pasture beyond the loess into the surrounding uplands (Bakels 1982; Kalis and Zimmermann 1988; Lüning 1991; Strien 2000; Ebersbach and Schade 2005; Ramminger 2005). In a review of vegetation, settlement, and economic evidence, Jens Lüning (2000, 190) concluded that Neolithic cattle husbandry was based on some degree of transhumance in which animals stayed outside year-round and were pastured in remote upland areas during the summer months and close to the agrarian settlements in winter.

In contrast, Amy Bogaard suggests that livestock keeping was small-scale and intensive (Bogaard 2004). She argues that the distinctly smaller sizes of domesticated pigs and cattle in comparison to their wild counterparts indicate that small herds were kept close to the settlements and interbreeding was prevented. This is in agreement with results from her work on botanical macro-remains that support the intensive gardening model for LBK crop husbandry and seem to make seasonal mobility unlikely.

In summary, assumptions about spatial organization of LBK cattle husbandry practices are so far largely based on environmental evidence and economic considerations that led to contrasting hypotheses. The hypothesis of seasonal mobility into upland areas (Lüning 2000; Ramminger 2005) stands against a small-scale and intense husbandry system in the immediate vicinity of settlements (Bogaard 2004).

Research potential and methodological background of strontium and oxygen isotope analysis

In the last decades, isotope and trace element analyses have been added to the methodological assemblage of physical anthropology and archaeozoology. They have proven to be valuable tools to investigate diet, seasonality and migration. In contrast to material culture studies, which can primarily make assumptions on a

group basis and on a rather general scale, these bioarchaeometric studies are based on skeletal remains from single individuals. Among the available isotope methods, strontium isotope analysis ($^{87}\text{Sr}/^{86}\text{Sr}$) is the most established method to study the mobility of people and their domesticated livestock, while oxygen isotopes ($^{18}\text{O}/^{16}\text{O}$ or $\delta^{18}\text{O}$) additionally record information about climate and seasonality.

Fundamental strontium isotope research has been carried out in geochemistry, where the rubidium-strontium isotope system was investigated to lay the foundations for a dating method for geologically relevant time spans (Faure and Powell 1972; Faure 1986). Biological investigations about the adverse health effects of ^{90}Sr are another basic line of research that concentrated on the incorporation of strontium into body tissues (Sillen and Kavanagh 1982, with further references). With a few earlier attempts at integration both lines of research developed largely independently in the 1950s and 1960s, when research objectives evolved and sufficient laboratory equipment became available (as reviewed in Knipper 2004). In the early 1980s, Jonathan E. Ericson (1981; 1985) pointed out the archaeological applications of Sr isotope analysis for the first time and summarised the research possibilities to investigate mobility and land use in prehistoric societies.

Because migration played and still plays a key role in LBK research, this time period was the focus of one of the earliest and so far most extensive strontium isotope studies in central Europe. Initiated in the late 1990s, research began on human remains from southwest Germany (as reviewed in Price and Bentley 2005; Bickle and Hofmann 2007). Only recently, teeth of domesticated animals were included to inform about husbandry practices (Bentley and Knipper 2005b; Knipper in prep.).

Strontium is a common trace element in bedrock. Its isotope ratio ($^{87}\text{Sr}/^{86}\text{Sr}$) in a human's or animal's diet depends on the geological bedrock of the region from which the food is obtained. $^{87}\text{Sr}/^{86}\text{Sr}$ of geological units varies with age and rubidium (Rb) content, because the isotope ^{87}Sr originates from the radioactive decay of ^{87}Rb . This decay occurs so slowly (half life 48.8×10^9 years (Faure 1986, 119)) that Sr isotope ratios as they are determined today can be used to draw conclusions about archaeologically relevant time spans.

Strontium isotope ratios commonly vary between 0.702 and 0.750, with low numbers in young volcanic rocks, intermediate ratios in limestone and sedimentary deposits, and high ones in old igneous and metamorphic rocks. Due to weathering of the bedrock, strontium becomes biologically available from the overlaying soil and groundwater. It is absorbed by plants and passed on through the food chain to animals and humans. As strontium isotopes are comparatively heavy, no fractionation occurs during this process and therefore the locally available isotope ratios do not change. In mammals, strontium is primarily incorporated into bones and teeth, where it substitutes for calcium. Tooth enamel is the material of choice for analysis. This very dense material with a low organic content forms the white outer layer of teeth. In human permanent teeth it mineralizes between birth and the 14th year of life and beyond, with systematic differences among different teeth (Schroeder 1987, 28–29; Schumacher *et al.* 1990, tab. 3; Olze *et al.* 2003). After its mineralization, tooth enamel is not remodelled. Thus, under appropriate preservation conditions, information about the origin of food during tooth formation stays preserved beyond an individual's lifetime and can provide

information about different residential places during that time (Knipper 2004; Bentley 2006).

The same mechanisms apply to animals. Strontium of dietary origin is equally incorporated during tooth formation. High-crowned teeth of cattle, sheep or goats are even better suited for isotope analysis than human teeth. Because much more enamel is formed in a shorter time, they allow for a higher temporal resolution of the results. In cattle, the three permanent molars are most suitable for analysis. They record isotope signals from a few months before birth throughout the animals' first two years of life (Brown *et al.* 1960; Figure 4). During that time, strontium isotope signals allow for the recognition of different feeding grounds or pasture areas, which informs about husbandry practices and the degree of mobility that was involved.

In addition, the spatial information that is derived from Sr isotope analyses can be combined with seasonal information based on oxygen isotopes. The isotopic composition of oxygen ($\delta^{18}\text{O}$ or $^{18}\text{O}/^{16}\text{O}$) in rain water, which animals ingest as drinking water, depends on temperature and other factors. In temperate climates, $\delta^{18}\text{O}$ of precipitation changes seasonally, so that in summer ratios are higher (heavier) than in winter (Stephan 1999). During tooth development, which is very complex but generally starts at the cusp and ends at the root, animals incorporate oxygen that correlates with their drinking water (Passey and Cerling 2002; Higgins and MacFadden 2004). Therefore oxygen isotopes in enamel can change along the growth axis of a tooth (Fricke and O'Neil 1996). Through analysis of multiple samples per tooth, it is possible to estimate in which season certain portions of the enamel were formed (Knipper *et al.* 2006; Paulus and Uerpmann 2007).

An optimal correlation of seasonal and spatial information can be reached by the analysis of both isotope systems on the same samples (Balasse *et al.* 2002). This allows for conclusions about whether the animals fed all year round from food that grew in the immediate vicinity of the village or if they spent certain parts of the year on remote pastures on varying geological bedrock. This information is derived from sequential sampling. Optimally, between six and ten samples that are equally spaced from the cusp to the root are removed from a tooth's crown with a dental drill and analysed for both oxygen and strontium isotope composition. Technically, it would be possible to obtain more samples (Balasse 2003), but this number gives sufficient temporal resolution while keeping costs for analysis comparatively low.

LBK human mobility: insights from strontium isotope studies

Isotope research on human skeletal remains from LBK sites in south and southwest Germany was initiated by T. Douglas Price and R. Alexander Bentley in the late 1990s and produced one of the most extensive Sr isotope data sets in Europe (Price *et al.* 2001; 2003; Bentley *et al.* 2002; 2003a; 2003b; Price and Bentley 2005). The original motivation of this research was to shed light on the role of migrant individuals at the establishment of the LBK and to contribute to the question of whether non-local people – presumed to be agriculturalists – migrated to the area and introduced the new economic system. Besides the role of migrants at the transition to a food-producing economic system, research focused on the interaction between potentially non-local agriculturalists and indigenous hunter-gatherers, not only during the earliest LBK, but also later, when remnants of a

Mesolithic population might have co-existed with LBK agriculturalists (Price *et al.* 2001; Bentley *et al.* 2003b; Bickle and Hofmann 2007).

Another set of questions that gained importance in more recent studies is mobility in the daily economic system and exploitation of resources from beyond the main settlement areas (Bentley and Knipper 2005b; Knipper and Price in press; Knipper in prep.). These questions include mobility at different times during human childhood, as well as the husbandry systems of the early domesticated animals in the region. These studies led to a more differentiated picture by including multiple samples per human jaw and skeletal remains of domesticated animals.

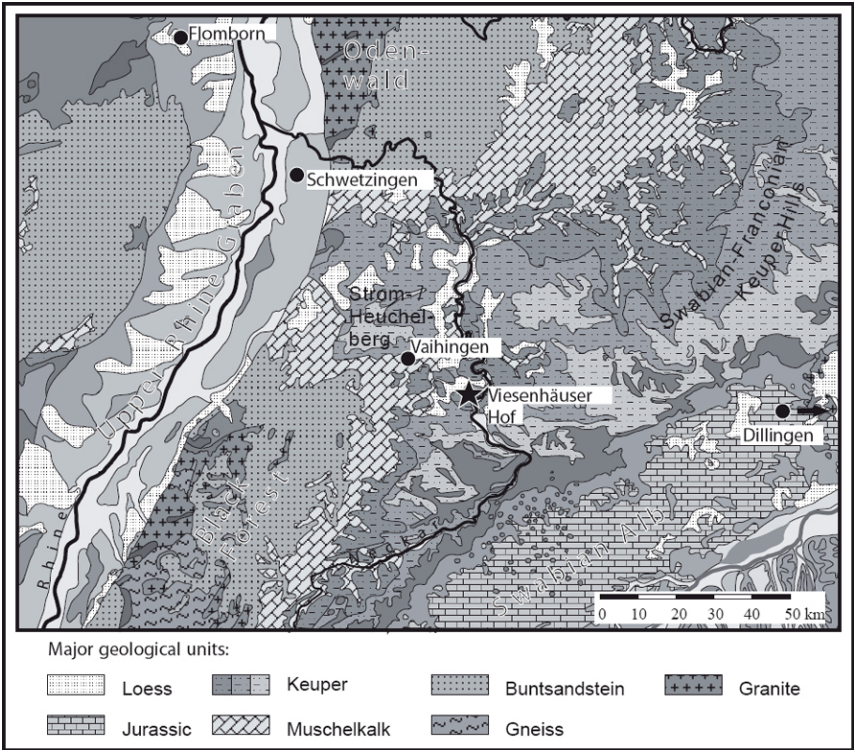


Figure 1. Simplified geological map of southwest Germany with locations of LBK sites subjected to strontium isotope analysis.

Biologically available strontium in south and southwest Germany and the identification of non-local individuals

The LBK sites analysed to date are situated in south and southwest Germany. The substantial geological variability of this area is reflected in the biologically available strontium isotope ratios (Price *et al.* 2003; Bentley and Knipper 2005a) (Figure 1). The highest $^{87}\text{Sr}/^{86}\text{Sr}$ ratios (0.714 and above) are found in the Palaeozoic granites and gneisses in the middle and southern Black Forest and in

the Odenwald. In large areas, these old bedrock formations are covered by a succession of Triassic and Jurassic sediments that form the characteristic South German Escarpments landscape (Geyer and Gwinner 1991). Although not yet fully understood in detail, biologically available strontium isotopes vary within and among these units, with higher ratios ($^{87}\text{Sr}/^{86}\text{Sr} > 0.710$) in sandstones such as the *Buntsandstein* and parts of the *Keuper* formation, and lower values ($^{87}\text{Sr}/^{86}\text{Sr} < 0.7090$) in calcareous rocks like the Middle Triassic *Muschelkalk* and the Upper Jurassic limestone (Matter *et al.* 1987; Ufrecht and Hölzl 2006). Parts of the *Muschelkalk* and *Keuper* are covered with loess, with typical Sr isotope ratios between 0.7090 and 0.7100. The lowest numbers in southwest Germany ($^{87}\text{Sr}/^{86}\text{Sr} \sim 0.706$) are found in Tertiary volcanoes, which for instance occur in the Hegau west of Lake Constance (Price *et al.* 2003; Knipper 2004; Bentley and Knipper 2005a).

These particular conditions are best suited for the investigation of mobility and land use practices beyond the most common settlement areas on loess in the Neckar area or Rhine valley and into the adjacent low mountain ranges of other geological bedrock. They are much less suitable to explore mobility between LBK settlements on similar loess soils that have comparable biologically available strontium, or to trace long distance migration, e.g. from southeast Europe, which is thought to be the origin of the LBK people (Price *et al.* 2001, 593).

Within this complex pattern of biologically available isotope ratios, there are several ways to identify individuals of non-local origin in a given data set (Price *et al.* 2002; Bentley *et al.* 2004; Knipper 2004; Bentley 2006). The most common option is still a comparison between tooth and bone isotope ratios from the same site. Conclusions about whether an individual migrated or not are often drawn either from the direct comparison of analytical results for teeth and bones from the same individual or, more reliably, an indirect comparison between a tooth enamel ratio and the 'local isotope range' of two standard deviations from the mean value of all bone ratios from a site. This approach was originally based on the assumption that bone data are biogenic isotope values that originate from dietary intake in the last years prior to an individual's death. Because bone remodels during life, recently ingested strontium gets incorporated and replaces strontium from a possibly different earlier residential area, so that its isotope ratio will change if strontium of different origin is absorbed after a residential change. However, in a growing number of isotope studies, bone was repeatedly found to be subject to contamination during burial. Therefore, originally non-local isotope ratios are likely to be erased and adjusted to the local labile strontium. This does not alter the local range as determined from bone values completely, but might narrow it.

Consequently, the local biologically available isotope range should be determined independently from the human burials under investigation, if at all possible. There are several alternatives that all have to be treated with caution and awareness of which natural or cultural factors might influence the analytical results. A local range based on comparative data from modern vegetation or water samples could be altered by contamination due to recent environmental pollution. Furthermore, because of their very limited catchment area, plants might show highly variable isotope ratios. Instead, tooth enamel from archaeologically preserved domesticated animals, especially pigs, seems to be a good alternative,

although one has to be aware that they might be influenced by husbandry practices. Domesticated animals consume food from a certain catchment area around a site and therefore average biologically available isotope ratios (Price *et al.* 2002; Bentley *et al.* 2004). Pig tooth enamel proved useful in estimating the local isotope variation at the LBK site of Vaihingen (Bentley *et al.* 2004). Nevertheless, if no such independent data are available, human bone is still a good estimate for the local biologically available strontium, even though the range might be narrowed due to contamination and adjustment to the very local values of the substrate in the immediate surroundings of the burial.

Results from published studies

The results of strontium isotope studies on human teeth from the LBK cemeteries of Flomborn, Dillingen and Schwetzingen, as well as burials in the settlement and surrounding ditch from Vaihingen/Enz, have been extensively published (Price *et al.* 2001; 2003; Bentley *et al.* 2002; 2003a; 2003b) and recently summarized and reviewed (Price and Bentley 2005; Bickle and Hofmann 2007). Figure 2 presents the Sr isotope ranges for these sites in rough chronological order for direct comparison. The grey bands show the local strontium isotope variations. At Vaihingen, they are estimated from two standard deviations from the mean value of 10 teeth of domesticated pigs (Bentley *et al.* 2004); at the other sites, where no numbers for domesticated animals are available, they are estimated from bone data. Data for human tooth enamel are grouped by sex and by locations within the Vaihingen site, where burials from the settlement and the surrounding ditch were analysed, and only by sex for the other sites. The following main conclusions can be drawn from a comparison of the tooth enamel data to the presented local ranges:

1. Non-local strontium isotope values are very common among all analysed burial communities. Although overall sample numbers are low and often only a small portion of the excavated burials was subject to analysis, non-local isotope values make up over 60% among the primarily earlier LBK burials from Flomborn and later LBK individuals from Dillingen. Among the larger assemblages from Vaihingen (primarily earlier LBK) and Schwetzingen (later LBK), about a third of the analysed teeth have a non-local isotope signature.
2. Non-local ratios are present among male and female burials in highly variable rates. Interestingly, all of the analyzed females from Flomborn and Dillingen have non-local values, including many that lie outside the range expected on loess patches in the study area ($^{87}\text{Sr}/^{86}\text{Sr} \approx 0.7085\text{--}0.7100$).
3. The non-local ratios are highly variable and fall either above or below the local variation. Although this has to be carefully interpreted considering the local geological conditions at each site, values above the local range are more common among most of the assemblages. The local ranges for Vaihingen, Flomborn and Schwetzingen are very similar with wide overlaps (overall between 0.7087 and 0.7102), while a somewhat lower range (below 0.7090) was established at Dillingen. This illustrates that many of the non-local isotope ratios cannot be explained by migration from one LBK settlement to another or by mobility between settlement landscapes on different loess areas. Biologically available strontium isotope values above 0.7100 do occur in south and

southwest Germany, but are not found in the preferentially settled loess landscapes. Instead, they are known from the adjacent uplands such as the Black Forest, the Odenwald or the upper Triassic sandstones and mudstones of the *Keuper* formation with common outcrops in Swabia and Franconia (Bentley and Knipper 2005a). The LBK archaeological record of these landscapes is very scarce. No settlements are known. Although a systematic review of published finds from the low mountain ranges and field surveys produced some evidence for the presence of Neolithic people in the uplands and an LBK presence cannot be totally excluded, the actual presence of early Neolithic people is not proven by the material culture record (Valde-Nowak 2002; Kienlin and Valde-Nowak 2004).

4. For the cemetery burials of Schwetzingen, Flomborn and Dillingen, correlations between strontium isotope data and burial orientation and certain grave goods, such as shoe last adzes, have been found (Price *et al.* 2001; Bentley *et al.* 2002). In detail, there is a lot of variability and no overall trends are visible. Even though in some cases a non-local origin of an individual might be reflected by burial orientation or material culture, variation within and among LBK burial communities might be caused by a number of other factors that are not reflected in the isotope ratios (Bickle and Hofmann 2007).

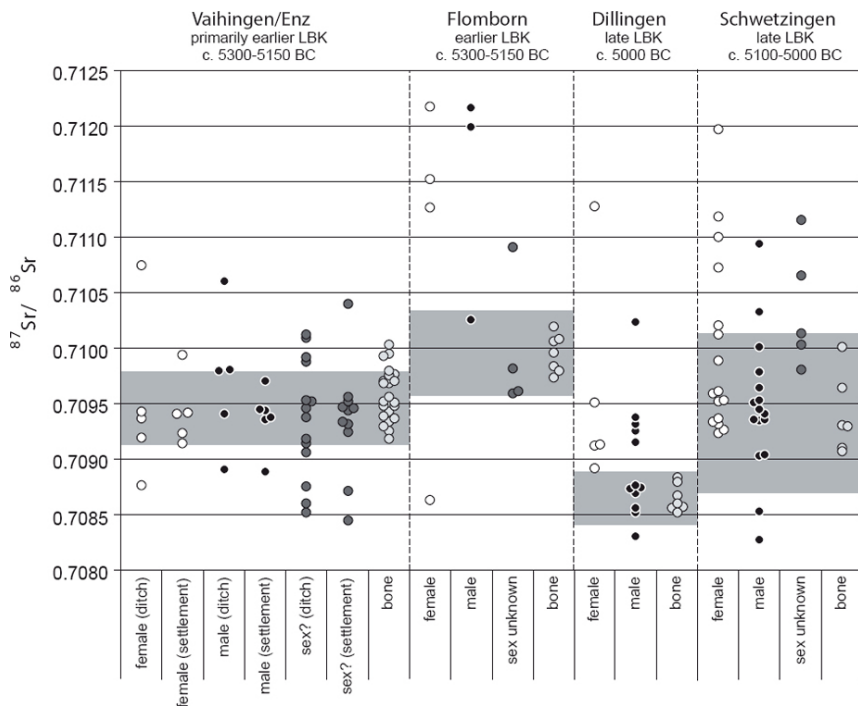


Figure 2. $^{87}\text{Sr}/^{86}\text{Sr}$ ratios in human teeth and bones from Vaihingen/Enz, Flomborn, Dillingen and Schwetzingen. The local ranges are shown as grey bands. At Flomborn, Dillingen and Schwetzingen, they are two standard deviations from the mean of all bone data; at Vaihingen, they are based on 10 analyses of pig teeth. Data after Bentley *et al.*

The published analytical results give evidence for very high rates of mobility that stand in contrast to the picture of a highly sedentary society suggested by the architectural remains of the LBK. Even more strikingly, many of the non-local values cannot be explained by intermarriage of people from other LBK settlements on typical loess soils, but show that food has been derived from the adjacent non-loess uplands.

It has to be kept in mind that the existing data reflect diet catchment areas during tooth formation in childhood and youth. They are either a reflection of actual residential changes or of economic behaviour and land use practices. R. A. Bentley pointed out that the analytical data from human teeth might not necessarily reflect the diet of a single location but may be mixed values that result from the potential exploitation of multiple landscapes and a mixed diet from different sources (Bentley *et al.* 2002, 802; Bentley *et al.* 2003b). This emphasises the fact that isotope data have to be carefully interpreted and placed into context with other archaeological and environmental evidence.

As recently reviewed in detail (Bickle and Hofmann 2007), it is a long way from the specific analytical results to conclusions about the mechanisms of the Neolithic transition in central Europe or assumptions about the interaction of late hunter-gatherers and early agriculturalists. One has to be aware that laboratory data are “no quick fixes for our ‘big questions’” (Bickle and Hofmann 2007, 1038), but only an additional aspect of the archaeological record, the interpretation of which is limited by common problems like chronological uncertainties, an uneven state of research in different landscapes and the very sparse archaeological record of the late hunter-gatherers in the research area.

Stuttgart-Mühlhausen ‘Viesenhäuser Hof’: a different picture from multiple analyses per jaw

The reviewed strontium isotope studies on LBK burials are based on the analysis of one tooth per individual, which represents only a part of the whole time span of human tooth development. More detailed information can be gained by analyzing multiple teeth per jaw that mineralize during different time spans until the 12th/14th year of life. Within these years, the recorded environmental information might change, mirroring residential changes and a person’s migration history (Schweissing and Grupe 2003a; Evans *et al.* 2006). Initial results from the LBK site of Stuttgart-Mühlhausen ‘Viesenhäuser Hof’ in Baden-Württemberg highlight the possibilities of a more detailed sampling strategy and draw a more complex picture of LBK human mobility.

The site of Stuttgart-Mühlhausen ‘Viesenhäuser Hof’ is situated on a gentle loess-covered ridge north of the modern city of Stuttgart. In several excavation campaigns through the mid 1990s, prehistoric settlement remains, an earthwork and an extensive cemetery were investigated (Biel 1983; Kurz 1994, with further references). Among the 247 burials 177 date to the LBK, although this determination is somewhat uncertain for some burials lacking grave goods (Price *et al.* 2003, 26).

There are two spatially and chronologically distinct burial groups, of which one

(area II, excavated in 1992/93) primarily dates to the earliest and earlier LBK (Flomborn phase) and the other (area I, excavated in 1982) to the middle and younger phases, or generally to the LBK (Biel 1983; Seitz 1989, 13; Price *et al.* 2003, 26; Kurz in prep.). The preservation of inhumations from several periods of the LBK allows the investigation of variation in burial practices and mobility patterns through time (Price *et al.* 2003; Knipper and Price in press; Knipper in prep.). Therefore, Stuttgart-Mühlhausen 'Viesenhäuser Hof' has been chosen for an extensive Sr isotope case study in which teeth and bones from 54 individuals from both burial areas have been analysed to date (Price *et al.* 2003; Price and Bentley 2005; Knipper in prep.; Knipper and Price in press). Initial results for one tooth per individual already demonstrated significant differences between the two chronologically distinct burial phases and showed first hints of systematic variation between early and late forming teeth (Price *et al.* 2003; Price and Bentley 2005). Based on these results, the sample set was successively extended up to nine samples from different teeth of the same individuals. In this paper, a few examples will show the potential of multiple tooth analysis and the more complex picture of LBK mobility that emerges from them.

The main results of the extended study in Stuttgart-Mühlhausen include differences between the two burial areas and between male and female burials in the earliest/earlier LBK section of the site. Figures 3a and b demonstrate common outcomes of the multiple tooth analysis in male individuals from burial area II (earliest/earlier LBK). The x-axes in the graphs illustrate the time spans of enamel mineralization of the sampled teeth, while their $^{87}\text{Sr}/^{86}\text{Sr}$ ratios are depicted on the y-axes. Because it was not always possible to sample the complete crown heights and because tooth mineralization varies among individuals, the isotope ratios are only representative for a varying section of the maximal time span of tooth formation as illustrated in the graph.

Burial 30, a 20–30 year old male individual dating to the earlier LBK, was buried with an antler toggle and a bone awl (Figure 3a). The strontium isotope ratios in his lower first permanent molars, which form between birth and an age of about 4 years, fall into the local isotope range as determined by two standard deviations from the mean value of all nine bone samples from the site. A lower M2, which mineralizes between three and seven years of age, has a slightly elevated $^{87}\text{Sr}/^{86}\text{Sr}$ ratio of 0.710 that indicates a diet of non-loess origin. Two M3 samples representing his 7th to 14th year, and possibly beyond, plot even higher at values of about 0.7105, significantly above the local range. A bone sample of $^{87}\text{Sr}/^{86}\text{Sr} = 0.709347$ falls perfectly into the local range.

Burial 47, a male individual who died between his 30th and 50th year of life, also dates to the earlier LBK and was buried with a shoe last adze, a pig's canine and red ochre (Figure 3b). The systematically sampled upper jaw shows similar differences among teeth with different formation times. Three samples of the two upper M1s fall consistently into the local strontium isotope range, while the M2 has an elevated, nonlocal isotope ratio. A sample from an upper second premolar also falls into the local range. The tooth's enamel mineralizes between two and seven years of age and therefore overlaps with both the M1s and the M2. Four M3 samples have very high isotope ratios of 0.7114–0.7116. Because M3s mineralize over several years, the upper right M3 was sampled close to the occlusal surface, which is the older portion, and a second time close to the root, which represents a

later time span. The highest isotope ratio in the occlusal sample suggests that the dietary/residential shift of the individual already occurred before the M3 began to mineralize, which means before his 7th year of life.

The demonstrated isotope shifts between local ratios in early forming teeth and non-local ratios in late forming enamel were found in 5 of the 13 sampled male individuals from the earliest/earlier LBK burial area II. In a 6th burial (burial 130), several early forming teeth had $^{87}\text{Sr}/^{86}\text{Sr}$ ratios above the local range (0.7101–0.7107) while an even more elevated ratio of 0.7116 was found in an upper M3. This indicates not only a non-local origin, but also a similar trend of isotope shifts towards elevated values in comparatively late mineralizing portions of enamel. In total, six male individuals (46.2%) have isotope ratios of non-local origin.

In contrast, exclusively local values were found in seven male burials (53.9%). In three of them the exclusively local dietary catchment during their whole childhood and youth is confirmed by multiple samples from enamel mineralized in different time spans. The local origin of four individuals is only seen in single samples, and non-local influences at other stages of childhood and youth cannot be excluded.

In female burials from the earliest/earlier LBK section of the Mühlhausen cemetery, isotope shifts from local to elevated non-local ratios as seen in males have not been found. Instead, non-local values occur regularly in tooth enamel that mineralizes during the first years of life, indicating a non-local birth place. Burial 43 for instance, an earlier LBK female who died at 22–25 years of age and was buried with two ceramic vessels and red ochre, has consistently elevated Sr isotope ratios (0.7110 and above) in the upper M1 and first incisor that represent the first two to four years of life. Isotope ratios in later forming teeth are somewhat lower, but with values above 0.7103 still well above the local isotope range (Figure 3c). Consistently non-local ratios are also seen in individuals 135 and 35, while a non-local ratio in an M1 of individual 77 shifts to a local one in the person's M3 (Figure 3d). In total, non-local values of some kind are found in 6 out of 12 (50%) female burials. Isotope ratios of the remaining 6 females under investigation are within the local range, but because only single teeth per individual have been analysed, some non-local influence cannot be excluded.

In the middle to younger LBK burial area I, 28 individuals were analyzed, some of them with multiple samples per jaw as well (Knipper and Price in press; Knipper in prep.). With only very few non-local Sr isotope ratios, and none of them above the local range, the results for area I are very different from area II.

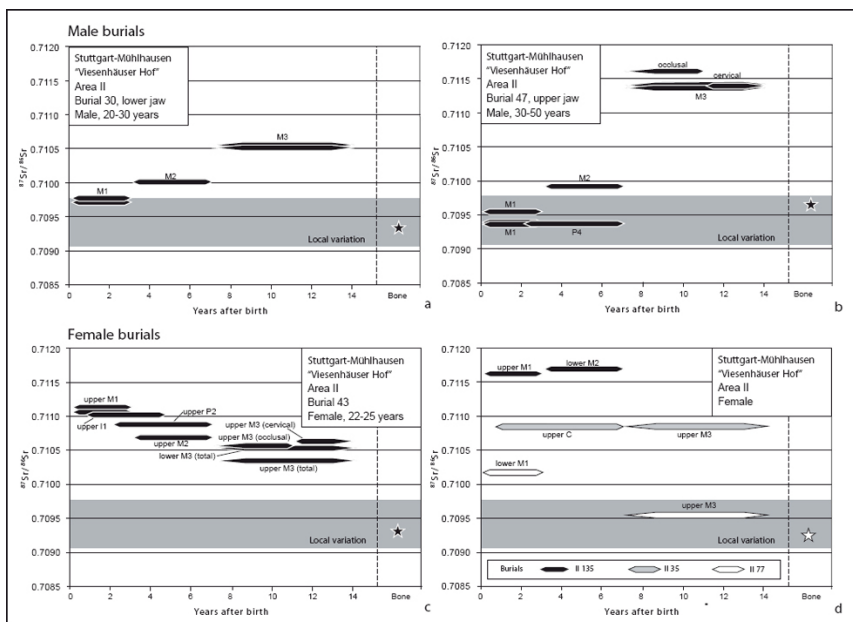


Figure 3. $^{87}\text{Sr}/^{86}\text{Sr}$ in human tooth enamel from earlier LBK burials from Stuttgart-Mühlhausen 'Viesenhäuser Hof'. Multiple analyses per jaw reflect different mobility patterns for males and females during childhood.

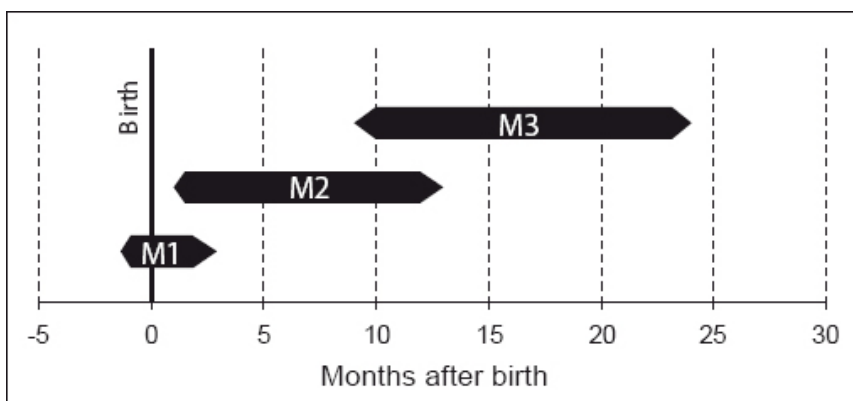


Figure 4. Time spans of tooth enamel mineralisation in cattle. Data after Brown et al. 1960.

These examples, drawn from a more detailed study with multiple samples from different teeth per jaw, show a much more complex picture of dietary catchment and residential changes during childhood than was possible in earlier studies with limited sample sizes. The fact that mobility during childhood is visible calls for multi-stage analytical strategies in which additional samples are chosen based on

earlier results. They should include samples from early and late forming teeth of the same individuals so that residential changes during childhood and early youth can be investigated.

In addition to the proposed methodological refinements, the data presented here invite researchers to think beyond residential changes between childhood and death and to consider several possible interpretations of gender-specific mobility, economy and land use during the course of the LBK. Based on material culture remains in settlements and on the existing isotope studies, LBK residential rules have been recently discussed (Bentley *et al.* 2003a; 2005). The isotope data for the earlier LBK burials from Stuttgart-Mühlhausen confirm former conclusions about patrilocality (Eisenhauer 2003; Bentley *et al.* 2005). Non-local isotope ratios in different teeth of females indicate that some women were migrants who either came to the site during their childhood or after reaching a nubile age.

In contrast, non-local Sr isotope ratios are almost completely absent in early-forming male teeth. This implies that most of the males were born in the settlement or isotopically similar loess regions. Nevertheless, the analytical results show that mobility also played a crucial role during the childhood of some of the men. Non-local isotope ratios in late-forming teeth suggest that during late childhood and early youth, an extensive portion of the diet was not obtained from the agricultural fields in the immediate surroundings of the settlement. The closest sources of such radiogenic isotope ratios are sandstones and igneous/metamorphic rocks in areas like the Black Forest or Odenwald, as well as the *Keuper* hills some tens of kilometres distant. Assuming that food was not traded into the LBK settlements from some distance and especially consumed by young men, the data imply that young men must have spent extensive time during their youth away from the site and other similar loess areas. Because human enamel samples always represent a mean of several years, it cannot be determined whether the elevated values are caused by a permanent residential change or by multiple episodes of regular mobility.

Even if it seems unlikely from today's point of view, there are ethnographic and historic examples of longdistance mobility among children and youngsters and extensive stays far away from home (e.g. Laferton 1982). Among others, one possible explanation for the young boys' mobility in the LBK is seasonal migration into low mountain ranges in order to herd domesticated animals. Numerous ethnographic examples demonstrate that even children of very young age are able to herd livestock (e.g. Whiting and Edwards 1988). Due to the largely forested landscape in the LBK (Schweizer 2001), herding was very labour-intensive and children were very likely involved in such tasks. Accompanied by older siblings or adults, they might have spent significant time with the herds beyond the immediate settlement landscapes, crossing geological units and taking up strontium from non-loess sources.

Spatial organisation of LBK cattle husbandry

While in many areas cattle are the most important domesticated animal during the LBK, south and southwestern Germany is an exception from this overall pattern. Here, the faunal assemblages are highly variable and often contain large portions of wild animal bones and different rates of other domesticated species, such as

sheep and goats or pigs (Müller 1964; Uerpmann and Uerpmann 1997; Stephan 2005).

Not only the presented isotope data of the Stuttgart-Mühlhausen human teeth, but also earlier published palynological and environmental data raise the question of whether seasonal mobility beyond the primary settlement areas on loess played a significant role in LBK cattle husbandry. While indirect botanical data led to contrasting hypotheses (Lüning 2000, 46; Bogaard 2004; Ramminger 2005), the faunal remains themselves contain direct information that has only recently begun to be explored (Bentley and Knipper 2005b). Although especially the high-crowned teeth of many domesticated animals can reveal much information about husbandry practices, archaeological applications of Sr isotope analysis so far largely focused on human skeletal remains, while biological and palaeontological attempts concentrated on modern and fossil wild animals (Chamberlain *et al.* 1997; Hoppe *et al.* 1999; Beard and Johnson 2000; Hoppe and Koch 2007).

Skeletal remains of domesticated animals from archaeological contexts either served as comparative values to isotope ratios in human teeth and to help determine the local range of strontium isotope variation (Bentley *et al.* 2004), or they were sampled to estimate the variation of biologically available strontium from different types of bedrock in a study area (Bentley and Knipper 2005a). The few existing strontium isotope studies with zooarchaeological objectives include investigations of early modern cattle horn cores (Schweissing and Grupe 2003b) and initial tests on tooth enamel that combine strontium and oxygen and/or trace element analyses (Balasse *et al.* 2002). They demonstrate the potential of deciphering dietary, spatial and seasonal information (Knipper *et al.* 2006; Evans *et al.* 2007), which is also crucial for understanding LBK husbandry practices. The following few examples of combined strontium and oxygen isotope analyses on cattle teeth from Vaihingen/Enz and Stuttgart-Mühlhausen 'Viesenhäuser Hof' shed first light on the diversity of husbandry practices within and among LBK sites.

Vaihingen/Enz is one of the largest excavated LBK settlements (Krause *et al.* 1998). An initial strontium isotope study on animal teeth from this settlement indicated that different domesticated species fed in different habitats, with the greatest variability in cattle and the smallest in pigs (Bentley *et al.* 2004). Building on these results, cattle teeth were chosen for a more detailed analysis that involved sequential sampling of individual teeth (Bentley and Knipper 2005b) and multiple isotope analyses (Knipper in prep.).

Figure 5 shows the results of strontium and oxygen isotope analyses on two cattle teeth from the same animal from Vaihingen/Enz (VAIH 3822). An M2 and M3 were sampled sequentially in equally spaced horizontal lines (Balasse *et al.* 2002; Balasse 2003) and each of the six samples per tooth was analysed for strontium and oxygen isotope composition. Strontium isotope ratios were determined as described in Bentley and Knipper (2005a) and oxygen isotope analysis on the phosphate component followed Tütken *et al.* (2006). The investigated tooth enamel mineralized during the course of about two years (Brown *et al.* 1960) (Figure 4) and recorded seasonal and dietary information during that time. The oxygen isotope curve of the slightly abraded M2 starts with a maximum, indicating that the animal was born in spring. After the following minimum, the $\delta^{18}\text{O}$ values rise again and overlap with the onset of the oxygen isotope curve of the M3 in enamel that represents the next summer. The M3

afterwards recorded isotope information of the next winter and the following summer before mineralization was completed.

Strontium isotope ratios from the same teeth allow an integration of seasonal and spatial information. The isotope curve starts inside the local range based on pig tooth enamel (Bentley *et al.* 2004), indicating that the animal was born on loess, very likely in the Vaihingen settlement, and spent its first months there. Then the strontium isotope ratios increased above the local range, which was obviously caused by a non-loess component in the animal's diet. Based on the oxygen isotope curve, this took place during spring and summer. In the animal's second winter, the strontium isotope ratios decreased again towards the local range and remained low into the next spring/early summer, when the two isotope curves ended. The combined isotope curves for VAIH 3822 give an example for seasonal mobility into a non-loess area. Because it is likely that an admixture of dietary intakes from several pasture grounds led to the elevated Sr isotope ratios, it is hard to locate the actual non-loess areas in the landscape. The closest sources of Sr isotope ratios in the shown range are in the Stromberg hills just north of the site, although a seasonal round into landscapes at a greater distance cannot be excluded.

As a second example of combined oxygen and strontium isotope analyses on LBK cattle teeth, STMÜ 8, an individual from Stuttgart-Mühlhausen 'Viesenhäuser Hof', is shown in Figure 6. Because oxygen isotope analysis is less costly than strontium, the oxygen isotope curve was established first. Based on the $\delta^{18}\text{O}$ results, samples that represent tooth formation in winter and summer were chosen for strontium isotope analysis in order to investigate seasonal mobility. The oxygen isotope curve begins with a winter minimum at the cusp of the M2. In the following summer, the curve overlaps with the M3 which recorded tooth formation in a cold and later a warm season. Strontium isotope ratios from all four extreme $\delta^{18}\text{O}$ values fall well below the local variation. With values between 0.70825 and 0.70836, they show very little diversity. This indicates that this animal was not involved in seasonal mobility between different landscapes, but also fed from pastures that were not covered by the typical Neckar area loess. Such low values are for instance known from early medieval human burials from Horb-Altheim (Obertová 2005), whose dietary catchment area was dominated by the middle Triassic *Muschelkalk* limestone. Small, steep *Muschelkalk* outcrops occur on the slopes of river valleys to the north and south of the site, and larger outcrops exist in the *Gäu* landscapes some tens of kilometres to the west.

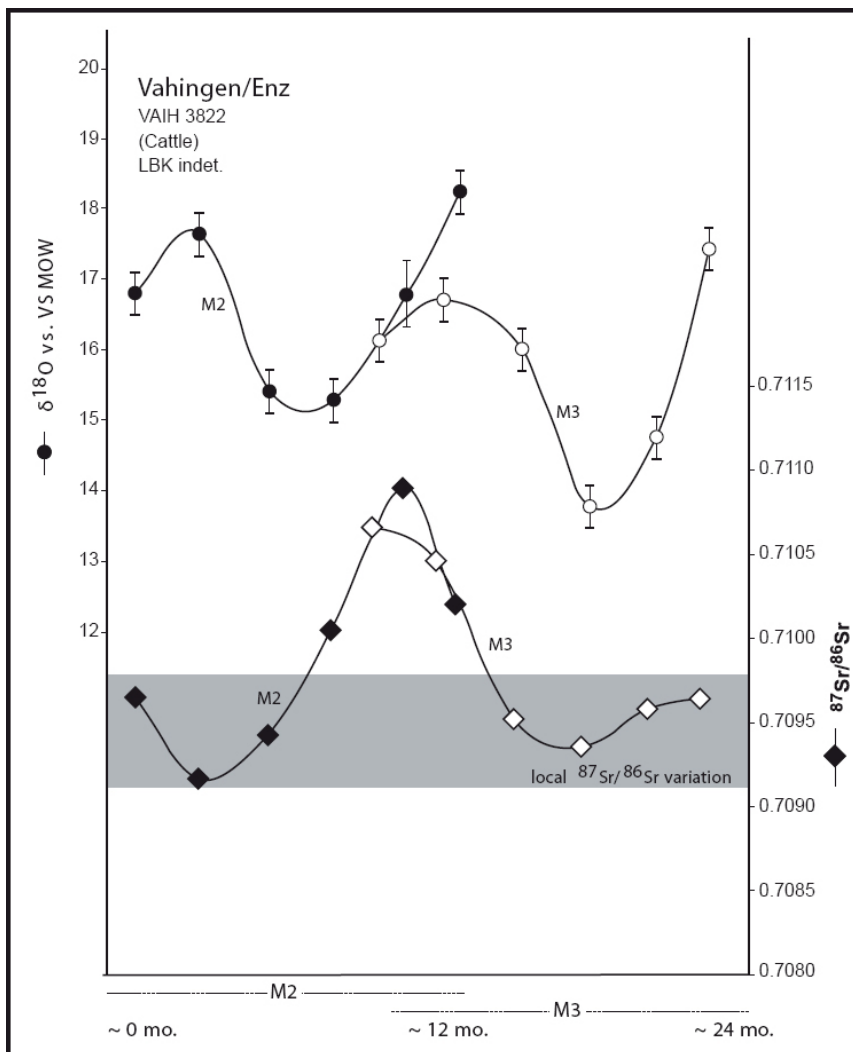


Figure 5. Combined strontium and oxygen isotope data for cattle VAIH 3822 from Vaihingen/Enz. The analytical results reflect seasonal movement beyond the loess patch on which the settlement is situated.

A different pattern of results from isotope analysis on LBK cattle remains is shown in Figure 7. Although in STMÜ 3, an M3 from Stuttgart-Mühlhausen, the oxygen isotope curve is less pronounced, a winter minimum and a summer maximum could be chosen for strontium isotope analysis. Both isotope ratios fell at the lower edge of the local isotope variation for the site, which indicates that feeding areas were primarily situated on loess, with some possible admixture from adjacent *Muschelkalk* during summer.

These few case examples demonstrate that there was no simple homogenous

strategy in LBK cattle husbandry in the Neckar area. In connection with further analysis (Knipper in prep.), they show that the animals could either be kept on the loess close to the settlements year-round, led to seasonal pastures in non-loess regions, or even introduced from outside. This raises questions about whether those animals came into the LBK settlements via exchange with communities whose catchment areas involved more non-loess patches, or whether these cattle were in some cases consistently kept away from the agriculturally favourable loess by the LBK people themselves.

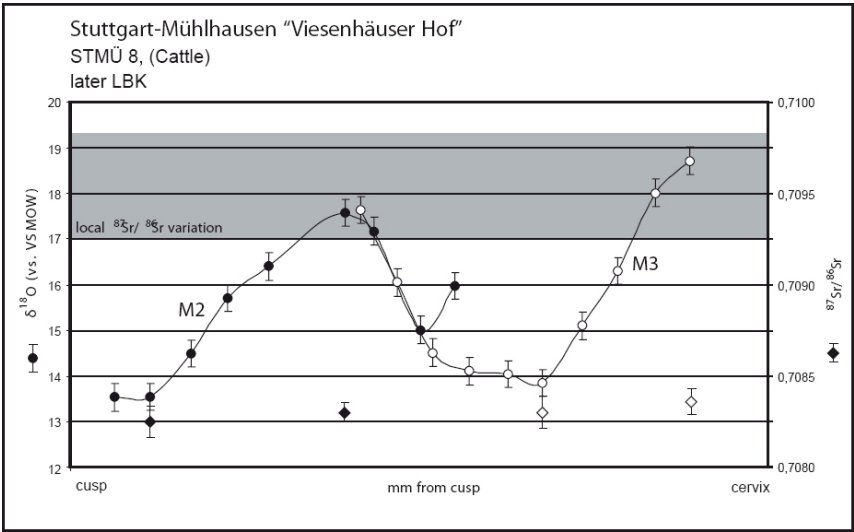


Figure 6. Combined strontium and oxygen isotope data for cattle STMÜ 8 from Stuttgart-Mühlhausen 'Viesenhäuser Hof'. The animal did not graze on loess during the whole 1.5 years reflected in the seasonal variation of the $\delta^{18}\text{O}$ data.

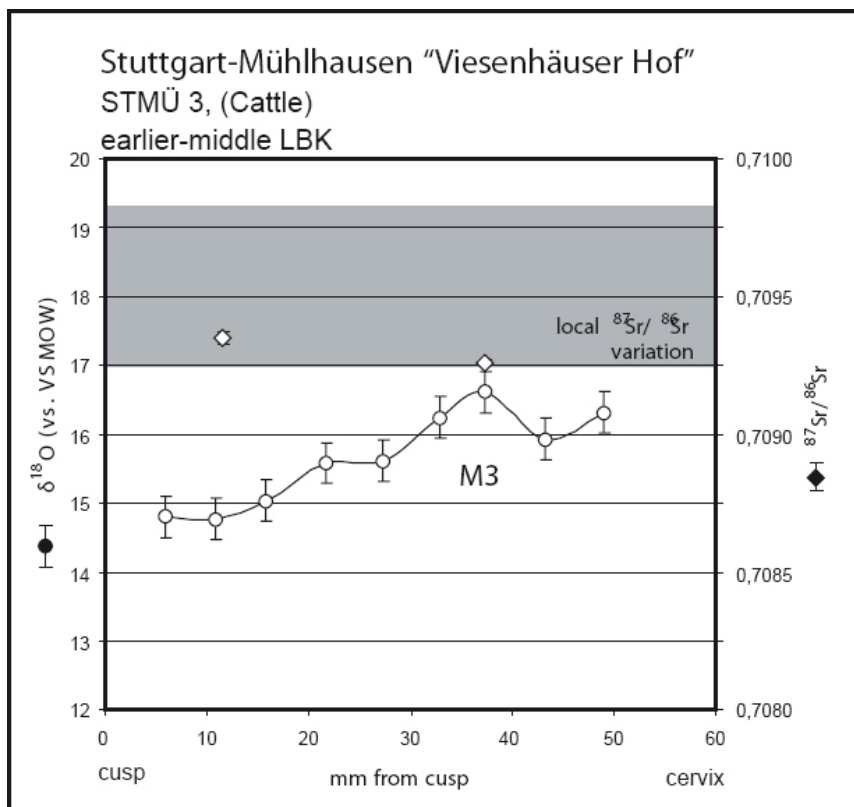


Figure 7. Combined strontium and oxygen isotope data for cattle STMÜ 3 from Stuttgart-Mühlhausen 'Viesenhäuser Hof'. The dominant food sources of this animal were derived from loess or similar sediments. There are no indications of seasonal mobility to remote pastures.

Much variation is seen within and among settlements in different landscapes. This leads to a very heterogeneous picture of husbandry practices, which is in accord with variation in the faunal assemblages of southwestern Germany themselves and with isotope patterns in human teeth. In both LBK cattle and human enamel, isotope ratios are highly variable and the question has been raised whether non-local isotope ratios in human tooth enamel, especially in the late forming teeth of male individuals from the Stuttgart-Mühlhausen cemetery, could be explained by herding activities of young boys. Unfortunately, well dated early LBK cattle teeth are very rare among the investigated faunal assemblage from the site. The only analysed cattle individual that is possibly contemporary with the human teeth shows variable Sr isotope ratios, but not in the same range as the non-local human values (Knipper in prep.). Although the existing data are not sufficient to connect information from domesticated animals and their potential herders from the same site, non-local isotope ratios in cattle teeth from Vaihingen, which lies on the same loess patch as Stuttgart-Mühlhausen, demonstrate that

similarly elevated strontium isotope ratios are found in both cattle and humans. They suggest that people and animals spent parts of their lives beyond the immediate settlement areas on loess, and that wider landscapes were involved in the LBK economic system.

Conclusions

The examples above demonstrate that strontium isotope studies in southwest Germany have great potential and are able to contribute to long-standing research questions about early Neolithic mobility and land use. Nevertheless, the successful application of isotope methods depends on the research questions, the sampling strategy and the chosen material. Southwest Germany is a geologically varied landscape, whose major geographical areas consequently vary in biologically available strontium. This is ideal for tracking land-use patterns on the scale of tens of kilometres, while the investigation of long-distance migration is much more complex. Not only are strontium isotope reference maps still lacking, but also the existing isotope studies of the last decade have shown that similar isotope ratios can occur in different landscapes. Therefore, the longer the distances in question, the more likely it is that similar biologically available isotope ratios in different areas will hinder the tracking of potential migrants back to their origins.

For the LBK, this means that finding out whether immigrants from southeastern Europe were involved in the Neolithic transition via strontium isotope analysis will be a difficult challenge. Not only will it be hard to actually sample first-generation immigrants, but also to rule out other potential places of origin for individuals with non-local isotope ratios in their teeth. Instead, at least in southwest Germany, isotope methods seem to be much better suited to investigations of land use patterns, resource exploitation and small- to medium-scale mobility.

The data presented here show that mobility played an important role in LBK daily life. Not only many human individuals, but also domesticated animals spent parts of their time in areas that do not belong to the characteristic loess basins which were the centres of LBK settlement activity. The patterns and mechanisms of such mobility are best seen in detailed analyses, which involve multiple samples from human jaws and the combination of strontium and oxygen isotope analyses on domestic animals' teeth. First results of this kind shed light on the extremely heterogeneous nature of LBK mobility, including gender-specific mobility during human childhood and mobility in animal husbandry systems.

Acknowledgements

For making samples available, technical support during laboratory work, valuable discussions and financial support during the course of this study, I wish to sincerely thank Dr. R. A. Bentley (Durham, UK), Dr. M. Brauns (Mannheim), Prof. L. E. Fisher (Springfield, Illinois), Frauenförderung der Fakultät für Geowissenschaften der Universität Tübingen, Prof. P. Fullager (Chapel Hill, North Carolina), the German Research Foundation, Prof. L. T. Grimm (Oberlin, Ohio), Dr. S. Harris (Santa Barbara, California), Prof. E. Pernicka (Tübingen), Prof. T. D. Price (Madison, Wisconsin), Prof. M. Satir (Tübingen), M. Schäfer (Basel), Dr. R. Schreg (Tübingen), B. Steinhilber (Tübingen), Dr. E. Stephan (Konstanz), Studienstiftung

des deutschen Volkes, Prof. H.-P. Uerpmann (Tübingen), the U.S. National Science Foundation (grant: BCS-0316125), and Priv. Doz. Dr. J. Wahl (Konstanz).

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New aspects and models for Bandkeramik settlement research

Oliver Rück

This contribution is a summary of parts of my doctoral dissertation, published in German in 2007, which critically reviewed LBK architecture and settlement structure on the basis of the Weisweiler 111 site on the Aldenhovener Platte, Rhineland, and other settlements. The interested reader is referred there for further detail and a fuller exposition and illustration of the points made here. This article aims to briefly introduce some new models for Bandkeramik settlement, including the secondary enlargement of buildings (additive building system), the row settlement model and the possible reconstruction of houses with a raised dwelling platform. The latter seems to have been necessary on most sites in order to compensate for the hill slope.

At first, I introduce the idea that LBK buildings were not static and may have been enlarged through time. The most commonly used typology of LBK houses is based on a scheme by Waterbolk and Modderman (1958/59), who classify LBK buildings according to the observed combination of characteristically disposed features, i.e. parts of a building's plan which are recognisably distinct and which they identify as northwest, central and southeast parts. They could show that:

- 1.the central part can occur as a structure in itself (*Kleinbau*; type 3)
- 2.the central part can be combined with a northwest part (*Bau*; type 2)
- 3.the central part can occur with both a northwest and a southeast part (*Großbau*; type 1).

However, this does not necessarily mean that all parts must have been built at the same time, an assumption which often underlies interpretations on house construction. Yet if we accept that structures could be secondarily enlarged, there are also consequences for the potential durability of the houses and hence for settlement layout and organisation. The second half of the paper hence critiques the widespread *Hofplatz* (or 'ward') model developed for the LBK in the Rhineland, which stipulates short-lived houses located far from their contemporary neighbours in autonomous wards. Instead, I propose a more planned, linear settlement layout (*Zeilensiedlungsmodell*). Finally, I offer some alternative reconstructions of LBK buildings based on the idea of a raised dwelling platform supported by posts.

Building-specific observations

When analysing house plans from Bandkeramik settlements, it becomes apparent that the majority of buildings exhibits morphological peculiarities. These either concern single elements of the buildings (postholes, wall trenches) or the structure of whole parts of the house (e.g. the northwest or southeast part). Numerous plans also stand out due to their specific constellation of house parts (e.g. combination of central and southeast part) and the accompanying loam pits.

The sheer number of instances of such peculiarities suggests a departure from the traditional, rigid LBK building scheme. The different characteristics of the Weisweiler house plans show that the degree of correspondence to a normative building scheme is reduced to a minimum. The site furthermore confirms the observation that building morphology changed over the course of the LBK (e.g. Modderman 1977). New ways of construction were experimented with and known ones were varied; inter-regional contacts probably also played a part here. It seems evident that the spectrum of architectural possibilities and fashions from which the builders of new houses could choose increased throughout the LBK.¹ Overall, this creates the impression that, beginning from the mid LBK and even more strongly in the late and latest LBK, the architectural uniformity and the normative trends in building construction within a settlement decreased. According to Coudart, too, the degree of architectural standardisation is smallest “at the time at which the Bandkeramik had reached its greatest extent” (Coudart 1998, 238). However, this seems to be partially opposed to the emergence of ‘ceramic’ regional groupings in the latest LBK.² This opposition could suggest that the different kinds of material culture groupings, houses and ceramic vessels, were bearers of symbolism with different intended messages.

Enlargement of buildings

When analysing the buildings from the Weisweiler 111 settlement, located on the Aldenhovener Platte in the Rhineland, it became apparent that in three buildings (No. 2, 3 and 4) the orientation of the southeast part diverged from the orientation of the longitudinal axis of the northwest and central parts. In plan, this appears as a southeast part at a marked angle relative to the rest of the house (Figure 1). Other observations also hint at the possibility that the southeast part could have been constructed after the central and northwest sections of a building had already been in use for some time. The later addition of a southeast part is also postulated for buildings 10 and 17. In the following, I will introduce examples from Weisweiler 111 and other settlements to suggest the enlargement of existing buildings during the LBK.

The southeast part of house 4 deviates from the length axis of the central part by 6° (Figure 2b).³ An additional post was noted at the transition from the central to the southeast part; it was probably necessary for the enlargement of the structure. The northwest part, too, showed numerous posts which deviated from the normal building scheme and which could hint at later refurbishments or repairs. Figure 2a shows the hypothetical appearance of the house before its suggested enlargement.

Having discussed a possible secondary enlargement with the example of building 4, similar processes can also be supposed for houses 2, 3, 10 and 17 (Figure 1). For building 2, the pottery recovered from loam pits could be used – in addition to the

plan – to argue for a secondary expansion: once the pottery from the pit diagonally in front of the southeastern end of the structure is dated by correspondence analysis, the material overall appears younger than the pottery from loam pit 357, beside structure 4.⁴

Other Bandkeramik settlements also feature buildings which were probably expanded and whose southeast parts diverge from the orientation of their central and northwest parts. In the following, I will use mainly structures from Elsloo and Stein in Dutch Limburg as examples, but further instances can be cited from Ulm-Eggingen (Baden-Württemberg) and Mold (Lower Austria). Figure 3a shows the hypothetical appearance of house 88 at Elsloo before the enlargement, and Figure 3b its actually observed plan. The southeast part, potentially added at a later date, and two pits accompanying it are marked in grey. In addition, two posts in the northwest part, also highlighted, may indicate further rebuilds or repairs. Overall, the observations already made for the Weisweiler buildings can be repeated here. In addition, the very short distance between the two post rows just northwest of the area with double posts is particularly noteworthy. What is more, the posts in these two rows are arranged offset to each other. This could be because the building enlargement necessitated an additional post row. In order to be able to move the beams necessary for an enlargement past already standing posts, any newly erected posts in this row (shown grey in Figure 3b) had to be offset. This may be the reason why the longitudinal post rows of the southeast part are not in a straight line with those in the central and northwest parts. It is hardly possible to find a clearer example of a secondary enlargement of a building by the addition of a southeast part. Houses 3 and 76 are further instances at Elsloo. As house 4 at Weisweiler 111, these buildings also feature loam pits which flank the southeast part only.

Summary of indicators for building expansion and/or repair⁵

1. Loam pits dug along the northwest and/or central part which end at the transition to the southeast part.
2. Loam pits accompanying only the southeast part (and mostly of the same length as the latter).
3. A different orientation of the southeast part respective to the northwest/centre.
4. 'Additional' posts or post row at the transition between central and southeast parts.
5. 'Additional' posts in the northwest and/or central parts which suggest repairs or rebuilds. This kind of additional posts seems to be absent from southeast parts.



Figure 1. Plan of Bandkeramik features at Weisweiler 111. Dotted lines are suggested reconstructions in areas disturbed by younger features.

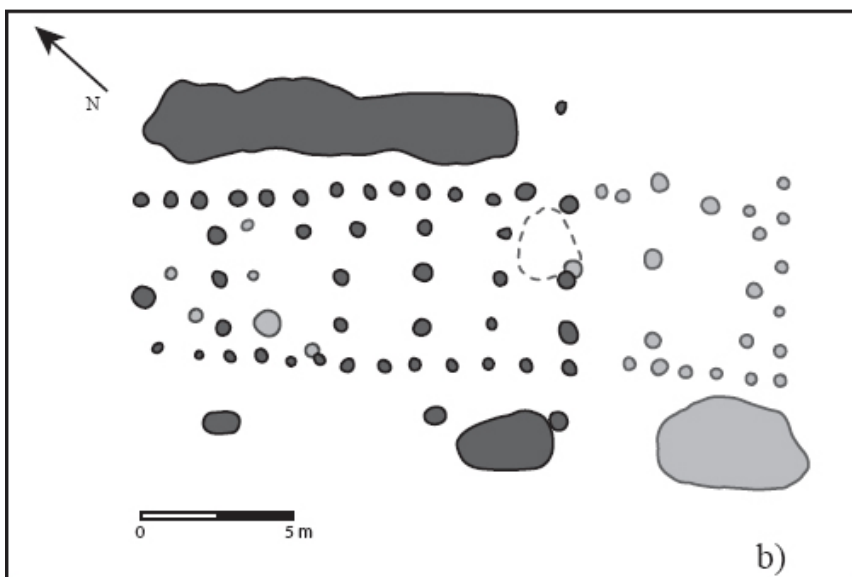
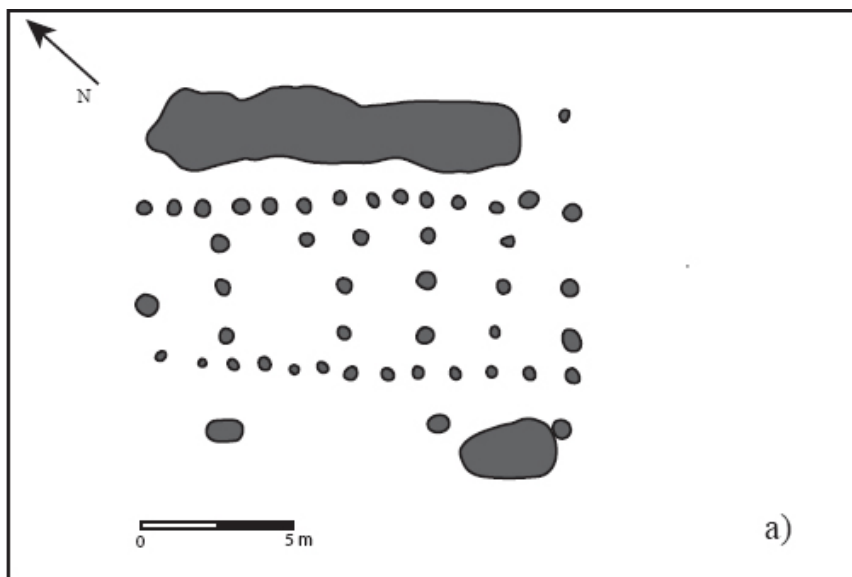


Figure 2. House 4 at Weisweiler 111. a) hypothetical appearance before enlargement. b) as excavated. The southeast part, offset by 6° from the rest of the house, a loam pit and some of the posts in the central part are marked in light grey; they may be connected to the episode of enlargement and possible repair.

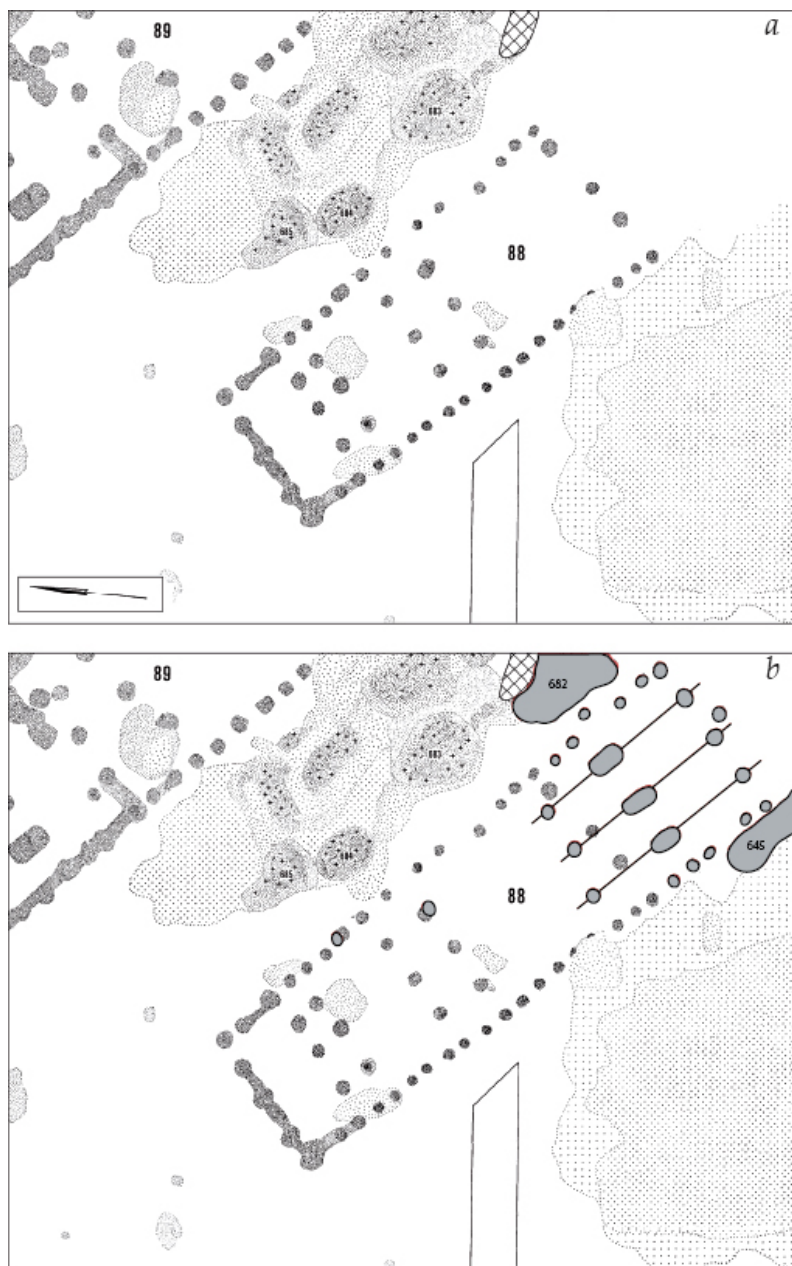


Figure 3. House 88 at Elsloo, Netherlands. a) hypothetical appearance before enlargement. b) as excavated. Modderman 1970, plate 36. Scale: 1:200.

The indicators listed above can appear singly or combined. This begs the question

of how far these observations reflect an underlying regularity and whether they can be paralleled for buildings from other sites. A first look at several settlement plans shows that this is indeed the case and that indicators of this kind can be found in large parts of the LBK distribution; a comprehensive gathering and statistical analysis of the data must, however, follow elsewhere.

These indicators for a secondary expansion of buildings may also be related to the observation that at Weisweiler 111, no type 3 buildings (*Kleinbau*) were revealed. Houses classed as type 2 (*Bau*) can equally not always be unequivocally identified. 50% of all houses excavated at Weisweiler 111 can be identified as type 1 (*Großbau*), a further 35% are not well enough preserved to allow a decision of whether they are type 1 or type 2 buildings. Some of these, too, can probably be numbered among the type 1 structures (e.g. house 10, possibly also house 17). The remaining 15% cannot be addressed in any detail. At this point, it must be mentioned that at the Langweiler 8 settlement, also on the Aldenhovener Platte, only three of the 108 buildings could be identified as *Kleinbauten*, and even these are not entirely certain (von Brandt 1988). At the LBK settlement of Kückhoven in the Rhineland, where 85 house plans could be reconstructed, there were no type 3 buildings at all (Lehmann 2004). How can we explain the small number of *Kleinbauten* at so many sites?

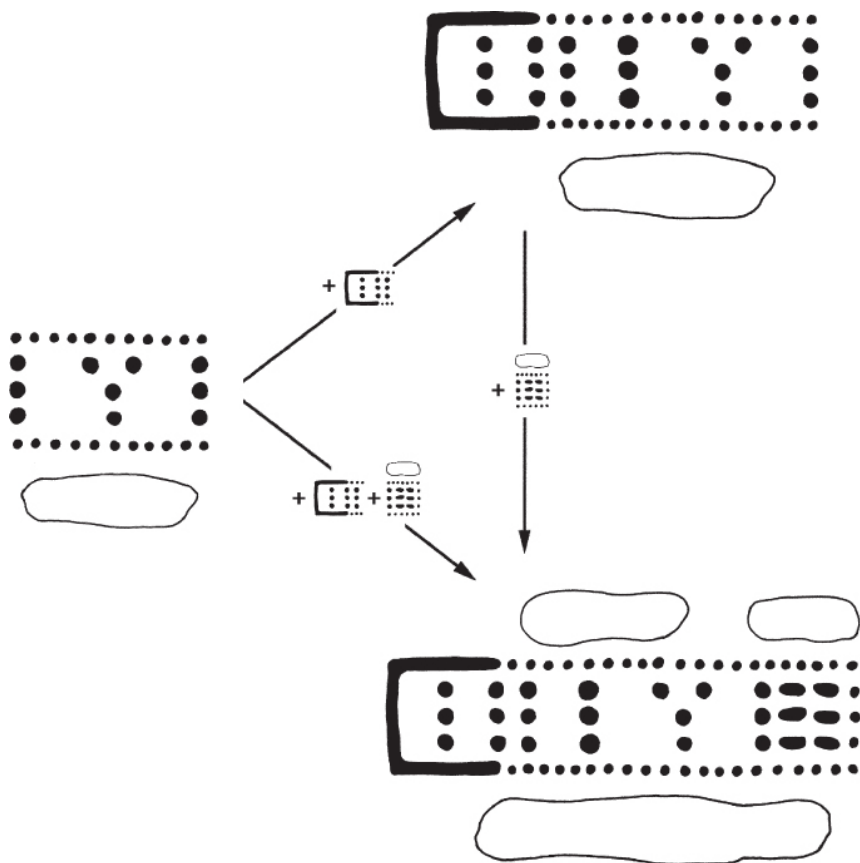


Figure 4. Schematic model of possible enlargements for type 2 and 3 LBK buildings (additive building system).

The model of house enlargement

For Waterbolk and Modderman (1958/59), the central part of a house is the fundamental element of construction present in every building type. Other combinations (double central part, or a central and southeast without a northwest part) have only been observed very rarely in the entire LBK area (e.g. Modderman 1988).

This scheme, based on different construction modules, seems predestined to be understood as a kind of building-kit system (additive building system; see Figure 4). This kind of outlook would mean that houses could well have been expanded in the course of their use life. Certainly not all buildings have been modified according to the model presented here, but it probably applies to a certain percentage of houses. With this in mind, some of the *Großbauten* on sites where this building type is uncommonly frequent and the occasionally small number of *Kleinbauten* could be explained.⁶ *Kleinbauten*, as well as some houses originally planned as *Bauten*, could thus have been enlarged with a southeast part some time

after their initial construction. Alongside the addition of a southeast part, it is possible that houses were later enlarged with a northwest part (as also suggested by Bradley 2001), or that the northwest part was extended, as can for instance be suggested for house 5 at Ulm-Eggingen.

These examples support the possibility of the secondary enlargement of buildings from a morphological point of view.⁷ Settlement geographers (e.g. Lienau 2000) have repeatedly pointed out reasons for structural changes to buildings in the course of their use, i.e. also including changes in family or social structure. “If a farmhouse at the point of its construction can be understood as a facility meeting a certain purpose, its functions and actual requirements often drift apart with the increasing age of the farm. [...] The building’s substance often renders a radical structural adaptation to changing operational conditions too expensive and difficult. Hence, an adaptation generally happens in stages, and only rarely radically through demolition and rebuilding at the same or a different location [...]” (Lienau 2000, 56–57).

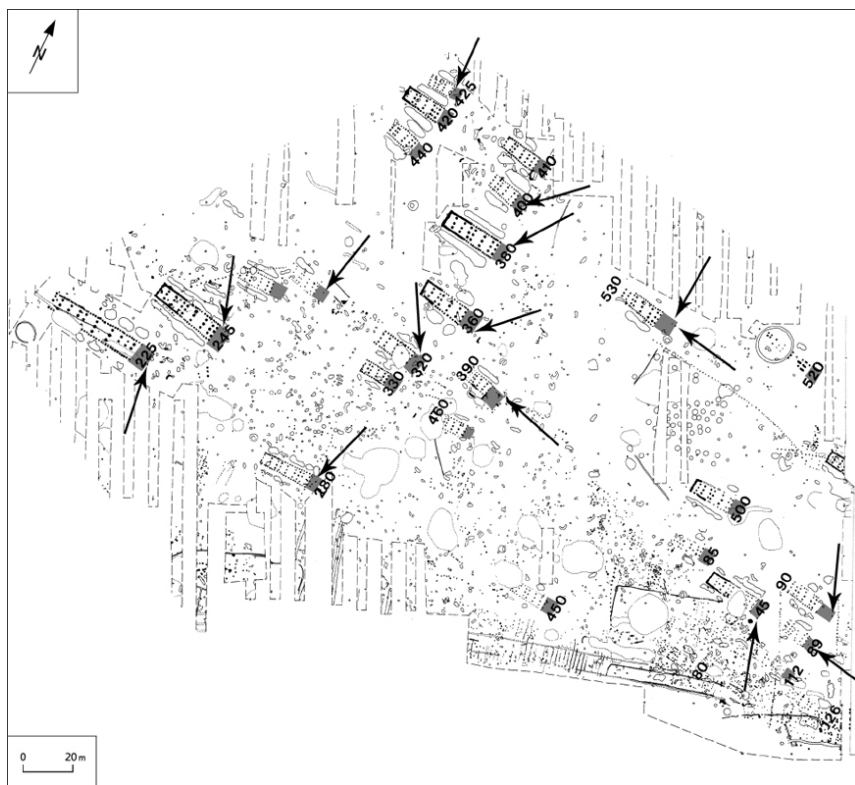


Figure 5. Plan of Cuiry-lès-Chaudardes, northeast France. Areas in front of the buildings which are virtually devoid of features are highlighted in grey. Arrows denote posts or groups of posts which are aligned with the house walls or longitudinal post rows in the interior. After Coudart 1998, 136, fig. 130.

The suggestion that houses could be enlarged, repaired or altered in the course of their use life has a fundamental effect on the plausibility of a settlement model first formulated about 30 years ago (Kuper *et al.* 1977). Now known as *Hofplatzmodell* (ward model), it attempted to explain the structure and development of an LBK settlement (e.g. Boelicke *et al.* 1988). The model divides a settlement into several spatial areas, the so-called *Hofplätze* or wards.⁸ The model implies that no two buildings could have stood on a ward at the same time. In addition, it assumes that each house was in use for roughly one generation, i.e. on average for about 25 years (Stehli 1989).

If we assume the secondary enlargement or repair of buildings, this would first of all point to the fact that houses were constructed with a longer span of use in mind and were lived in for a considerable time – probably for much longer than the postulated 25 years. This would mean a much larger number of contemporary houses and hence more inhabitants in a given settlement. Consequently, to retain the *Hofplatzmodell*, one would either have to increase the number of wards or the number of contemporary houses per ward. However, this would also mean that the minimum distance between contemporary houses, generally quoted as 25–50 m, would have to be reduced. As neither of these options can be reconciled with the *Hofplatzmodell*, the alternative is to suggest a new model altogether.

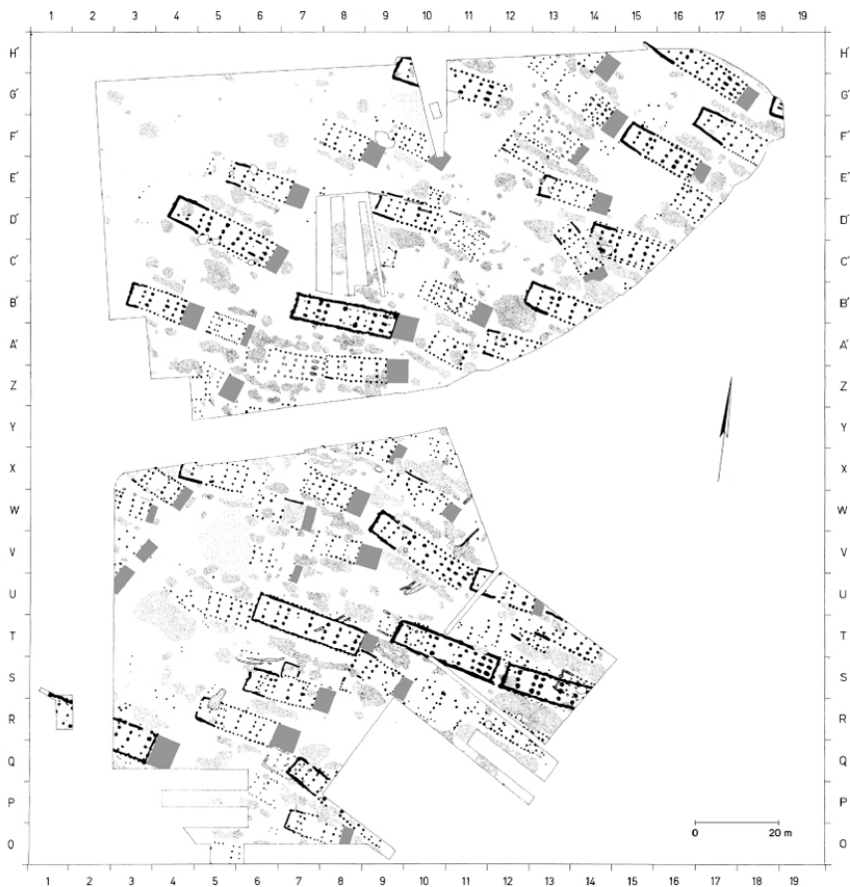


Figure 6. Plan of Elsloo, area west of the Koolweg. Areas in front of the buildings which are virtually devoid of features are highlighted in grey. After Modderman 1985, Beilage 2.

Settlement-specific observations

At the Weisweiler 111 site, there are no overlapping LBK house plans.⁹ The buildings at this site show a regular arrangement – they are grouped in several spatial clusters and lie alongside each other with a roughly parallel orientation (Figure 1). The settlement plan thus appears structured and intentionally shaped and is well suited for considerations of settlement structure and development. At smaller sites or those with few overlapping house plans, the formation of the settlement can be more easily traced than at large and long-lasting ones such as Köln-Lindenthal, Bylandt or Langweiler 8. The observable characteristics of such an intensively built-on site are the outcome of several decades or centuries of settlement activity in the same location. These constant activities can result in unclear site plans with numerous intercutting houses, as is the case at the sites mentioned above. Where the “original regularity of a facility is crippled beyond

recognition by later building works [...]” (Lienau 2000, 66), it seems less suitable for the construction of models.

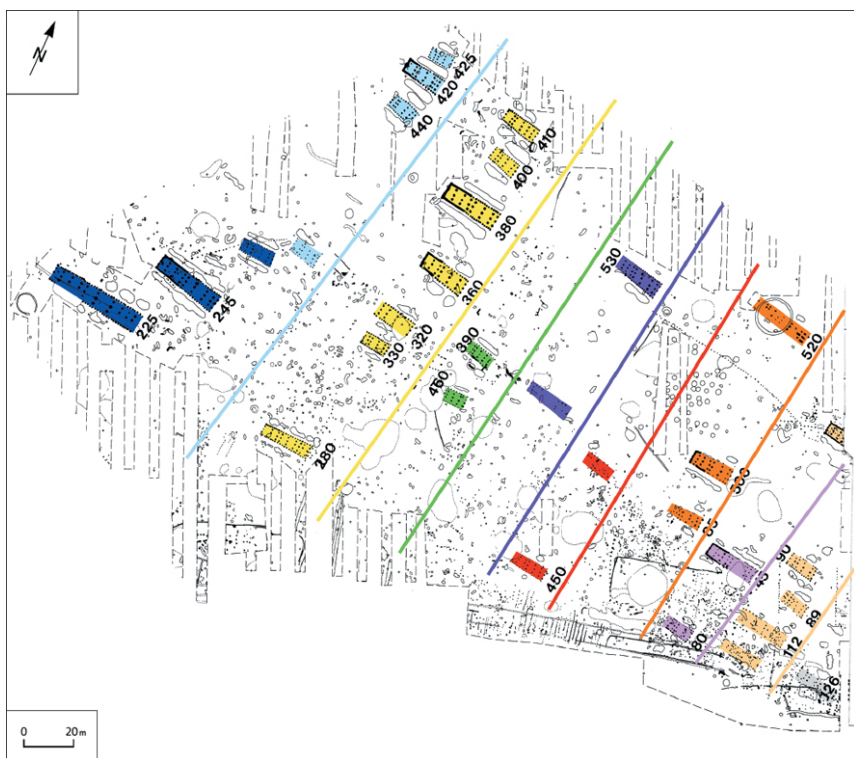


Figure 7. Cuiry-lès-Chaudardes, showing linear arrangement of roughly parallel houses. Although there is no type 1 building, each row seems to have a house which stands out due to its size (length and/or width). After Coudart 1998, 136, fig. 130.

Using Weisweiler 111 as an example, I will outline structural principles which are observable on the majority of Bandkeramik settlement plans (for instance at Cuiry-lès-Chaudardes, France; the Dutch sites of Elsloo and Geleen-Janskamperveld; at Frimmersdorf 141, Ulm-Eggingen and Regensburg-Harting in Germany; and at Füzesabony-Gubakút, Hungary) and point towards a settlement structure which is fundamentally different to the *Hofplatzmodell* (Boelicke *et al.* 1988). The following paragraphs outline the observations which led to this conclusion in more detail.

The feature-free area in front of the southeast end

A closer look at the plans of LBK settlements, especially at those where house plans only overlap to a small extent, shows that the area immediately in front of the southeastern or southern end of a house is generally devoid of features. This observation can be replicated for most sites. At Weisweiler 111, it can be made for

eight or ten buildings (Figure 1), but this peculiarity is also evident at other settlements.¹⁰ It is supposed that this area was somehow connected to the house. One possibility is the existence of an unpreserved terrace raised above ground level (Figure 20).¹¹ Posts which occur as extensions of a building's outer walls or of the interior longitudinal post rows could hint at such a porch or extension. At Weisweiler 111, traces of such posts were observed for houses 3 and 4; at Cuiry-lès-Chaudardes for buildings 45, 89, 90, 225, 245, 280, 320, 360, 380, 390, 400, 425, 500 and 530 (Figure 5, highlighted by arrows). Due to their frequent occurrence, these single or grouped postholes can no longer be regarded as coincidental.

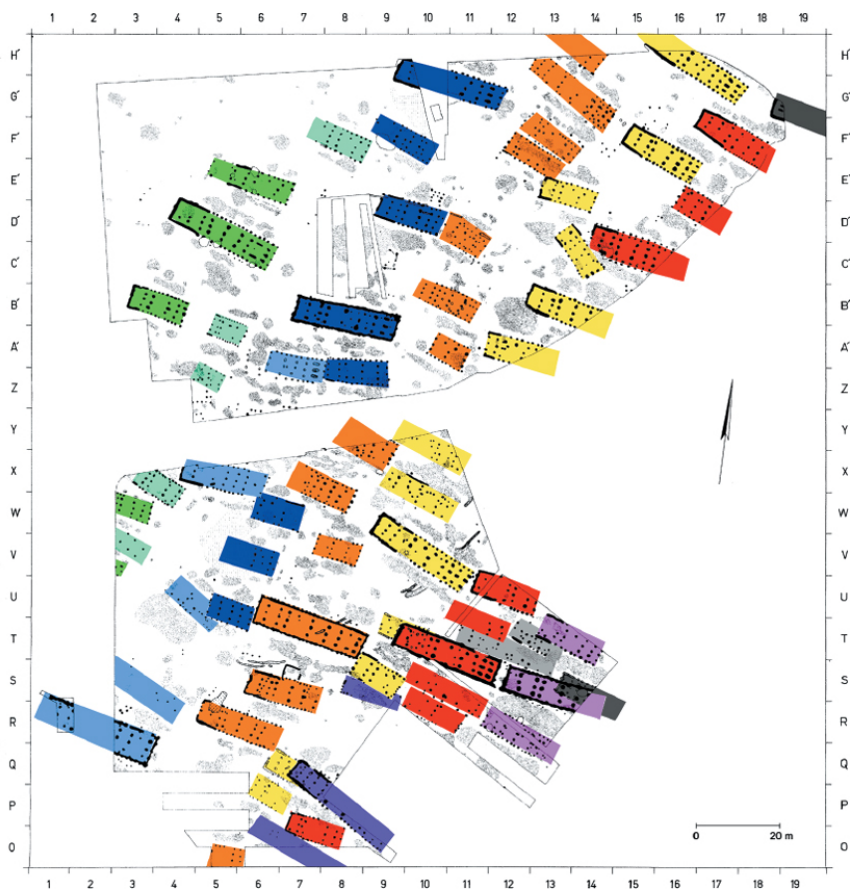


Figure 8. Elsloo. Houses of the same colour seem to form rows. Note the few overlaps, which appear mostly between narrow sides of structures. This suggests that houses in the same row could have existed simultaneously. Also note that the five type 1 houses belong to five different rows. Light grey houses cannot be attributed unequivocally. After Modderman 1985, Beilage 2.

As far as the durability of LBK houses is concerned, it seems interesting that even at settlements with a greater density of buildings and several parallel house plans with aligned gable ends, the areas to the southeast of the structures are devoid of features. This makes it likely that more of the houses were in use simultaneously. If this had not been the case, this empty area could have been used for digging pits or for the construction of new buildings. This is especially clear at the sites of Elsloo (Figure 6) and Ulm-Eggingen, where the areas in front of the houses have remained devoid of features in spite of the frequent intercutting of house plans. Even between the different rows of houses, the area immediately to the southeast of the structures rarely yields any features and is only overlaid by later houses in very densely built-over areas of the site.

Aligned gable ends and parallel houses

The analysis of numerous site plans shows that most LBK settlements in central Europe have one factor in common: within the site, groups or rows of parallel houses with aligned gable ends can be identified. The distance between individual structures varies between one or two building widths. The number of houses arranged in this way seems to vary with the size and extent of the site. Thus, at Straubing-Lerchenhaid in Bavaria, there are at least two pairs of parallel buildings with aligned gable ends (Brink-Kloke 1992, 10; fig. 1.8). In the southern part of Ulm-Eggingen, three houses (buildings 6, 4 and 8) lie parallel to each other and their southeastern gable ends are located on a shared baseline or alignment. The largest number of parallel buildings with aligned gable ends was observed at Cuiry-lès-Chaudardes in northeast France (Figure 7). Weisweiler 111 shows a similar arrangement of houses. Here, buildings 2, 4, 5 and 9 lie next to each other and feature aligned gable ends. Before its suggested extension, the gable end of house 3 would also be aligned with that of the other buildings (Figure 1). At settlements with large numbers of overlapping house plans, the original settlement structure, or *initial form*, has often been greatly modified. Nevertheless, parallel buildings with aligned gable ends can also be recognised over larger distances within such sites. Although the numerous instances of intercutting houses hide the structured arrangement of buildings, if such later houses are metaphorically blinded out the original settlement plan can often be filtered out. This is for instance the case at Elsloo (Figure 8), Langweiler 8 and Regensburg-Harting (Becker and Braasch 1984).

On the basis of settlement geographical investigations of historical and recent settlement forms, it can be suggested that parallel buildings with aligned gable ends are contemporary to each other (Lienau 2000). As an example, one could cite central European rural settlements, where farms are strung out along the main street. Cities, newly developed areas or terraced housing could be added here. Ethnographically documented settlements in southeast Asia, for instance those of the Batak on Sumatra (Guidoni 1976) or of the Toraja on Sulawesi (Fraser 1968) also illustrate the contemporaneity of neighbouring buildings (Figure 14). The lake-side settlements of the Alpine foreland can be quoted as an archaeological example for regularly placed contemporary houses. In all, these observations suggest that on LBK settlements, too, a large part of parallel buildings with aligned gable ends was in use simultaneously.¹²

Settlement structure – the arrangement of houses in rows

“The form of a settlement results from the shape of the settlement plan and the density of buildings. The settlement plan is the result of the arrangement of the houses and/or yards which are combined into a settlement unit and their relationship to the streets (paths) and squares” (Lienau 2000, 64). Can we also recognise a specific settlement form for LBK sites? The analysis of several settlement plans shows that houses were arranged in rows. Within a row of houses (or settlement row), neighbouring houses are not or only marginally offset longitudinally. The observed width of such a row lies between one or two house lengths (Figures 7–14).¹³ The number of rows probably depends on the size and duration of the settlement. Equally, not all houses in a row need to have existed at the same time. There is, however, the possibility of coexistence, especially where no overlaps of houses are observed. The appearance of a row of houses probably changed over time: new buildings were added, old ones decayed or were built over. A settlement plan with houses laid out in rows can be reconstructed for most sites – even where the original settlement structure was hidden by high levels of settlement activity and overlaps.

Until now, LBK sites have not been systematically examined for a row-based settlement structure. This can be explained by the predominance of the 30-year-old *Hofplatz* model and the fact that, for the Rhineland at least, alternative interpretations did not seem necessary. In the course of inter-regional investigations on the LBK, Coudart (1993, 128) reached the conclusion that settlements could generally be divided into five spatial units. These units could be linear or irregular. Although her figures show a row-based structure for several settlements (Coudart 1993, 129, fig. 15) she does not interpret them in this way. In all probability, she was influenced by the Rhenanian model,¹⁴ as well as assuming only five contemporary longhouses for large LBK sites.

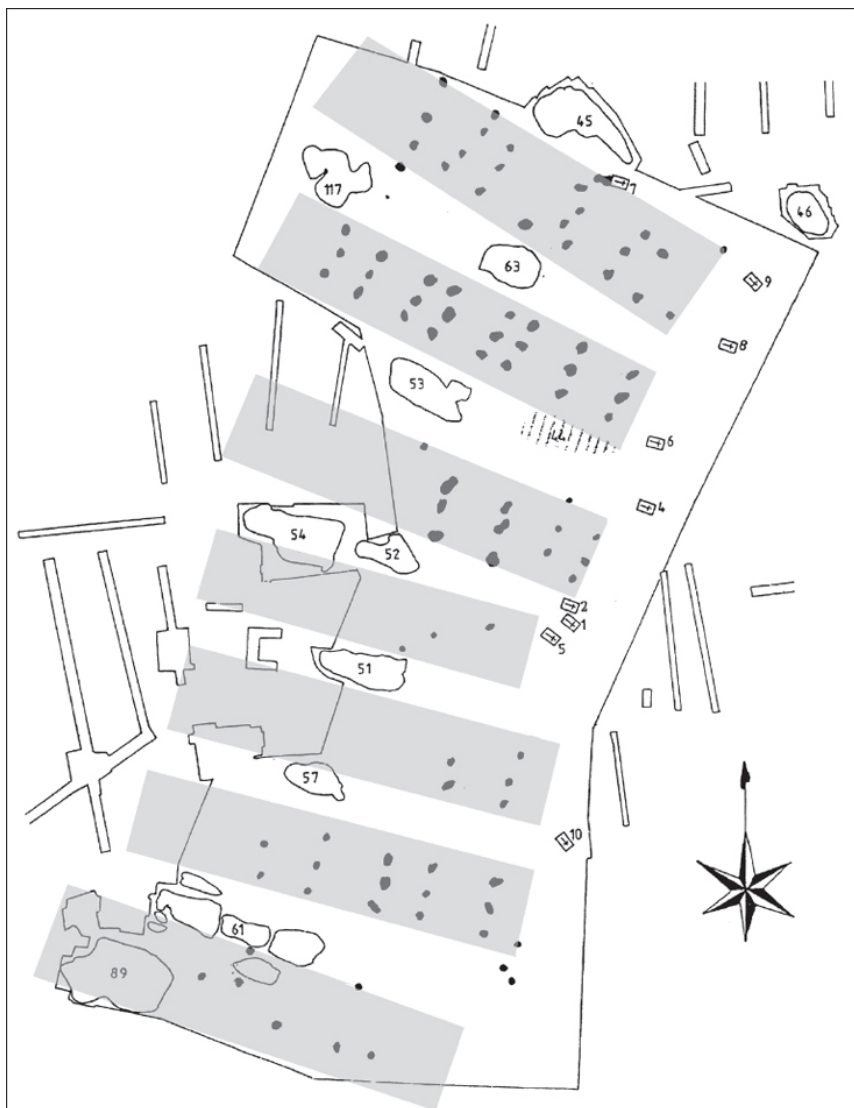


Figure 9. Füzesabony-Gubakút, northeast Hungary. Part of area excavated in advance of motorway construction (M-3). Note the parallel arrangement of houses and their aligned gable ends, as well as the aligned loam pits. Domboróczki 2001, 197, fig. 4.

Domboróczki (2001) described a linear arrangement of buildings on Alföld-LBK sites (Figure 9). Based on his original observation that large pits on the northeast Hungarian site of Füzesabony-Gubakút were arranged 8–10 m apart in rows, Domboróczki's analysis of the settlement features reached the following conclusions: "The most important result of the excavations at Füzesabony-Gubakút was the recognition of the settlement structure of the ALPC [Alföld Linear Pottery

Culture]. The settlement consisted of four parallel rows, with two rows situated along both sides of a one-time riverbed. The settlement rows were composed of houses and refuse pits” (Domboróczy 2001, 202).

The illustrations of several settlement plans presented here were the starting point for the description of the Bandkeramik village as a continuously growing settlement in which several parallel rows of houses were in use at the same time (Figures 5–13).¹⁵

On the reconstruction of Bandkeramik buildings

A truthful reconstruction of LBK houses is a difficult task, and one which remains unresolved in detail. This could change through further finds such as the well from Kückhoven or the discovery of similarly well-preserved house walls, roofs or walking horizons. For now, we can only base our tentative conclusions of the above-ground elements of the house on detailed observation and documentation of the dug features and their embeddedness into the site’s topography.¹⁶ The houses thus reconstructed will only roughly reflect prehistoric reality. Most architectural characteristics, such as interior subdivisions and features, roof construction, windows, entrances and the question whether the building had more than one floor are as impossible to determine as the details of a probably highly developed decoration and colour scheme.

For the past 70 years, there have been suggestions on the reconstruction of LBK buildings from structural, economic, technological and static points of view (Buttler and Haberey 1936; Paret 1946; Meyer-Christian 1976; Startin 1978; Lüning 1980; Masuch and Ziessow 1983; von Brandt 1988; Luley 1992). Ever since Paret’s (1946) criticism of Buttler’s theory of pit houses and raised granaries (Buttler and Haberey 1936), the patterned postholes of an LBK building are used to reconstruct the same, ground-level building all across central and western Europe.¹⁷ In spite of the large number of archaeological finds – more than 2000 investigated LBK house plans – it cannot be proven whether ground-level houses even existed in the Bandkeramik. Part of the reason is that the former walking horizon was destroyed by erosion, resulting in most information being lost. The reconstruction accepted at present is hence based on hypotheses which, in the course of research into the Neolithic, assumed paradigmatic traits.¹⁸

On the topography of LBK sites

However, observations on the topography of LBK sites (Rück 2004) and investigations on climate at the time (Schmidt *et al.* 2004) make the interpretation of a ground-level living space seem doubtful. As early as 1972, Sielmann summarised the topographic location of LBK sites as follows: the settlements were generally located on the top or the upper third of rises sloping down to watercourses or on the edge of loess-covered river terraces (Sielmann 1972). New information from LBK sites confirms these general patterns and forcefully demonstrates that steep slopes were chosen as settlement sites. Table 1 shows the topographic situation on slopes of 14 LBK sites, but could be extended to almost all settlements in southern and western Germany, as the following examples show: mapping more than 100 LBK sites in the area of the Nördlinger Ries, Bavaria,

shows settlement concentrations on the slopes at the edge of the Ries and along river courses. The Ries itself, i.e. the fertile loess soils in the plain itself, in contrast, remained largely devoid of settlement (Zeeb-Lanz 2003, 296–98, maps 1 and 2).

Similarly, settlements along the Merzbach valley on the Aldenhovener Platte are also concentrated on rises or valley slopes descending towards the Merzbach stream (Lüning and Stehli 1994, IX). Parts of the Langweiler 9 settlement lay on a slope which dropped three metres over a distance of 75 m (from 134 to 131 m above sea level) in the area of houses 8 to 11 (Lüning 1982, 24, fig. 10). A comparable situation exists in Poland. “The Danubian I population nearly always colonised the lower part of the valley slopes. The settlements were situated at their edges immediately above the inundated terrace covered with silts of various rotation” (Kruk 1973, 250). Plateaux or plains adjacent to the higher ground were not settled. The settlements at Geleen and Sittard can stand as examples for the Dutch Limburg. Waterbolk and Modderman (1958/59, 36) describe the topography of Sittard as follows: “Globally speaking, the contours run north-south. Before modern house construction, the largest height difference was 4.75 m. However, this figure increases further if we consider the level at which the Bandkeramik features were found; here, it is 5.5 m”.

Soil scientific investigations confirm that erosion processes led to erosion in post-LBK times and contributed to a levelling of the ground (Schalich 1977). Kuper *et al.* (1975, 17) note: “Intensive mapping of soil types in the Merzbach area showed that this landscape was much more structured 6000 years ago and featured much greater height differences than today. Thus, the Neolithic Merzbach valley lay up to 4 m below the modern-day ground level, while the hill slopes have to be imagined as augmented by the mass of the since eroded soil”. This observation can be applied to other loess areas. For the Wetterau region in Hesse, Thiemeyer (1988) established a flattening of slopes of 50%, i.e. a prehistoric gradient of 15% is only 3–6% today. The gradient at the sites listed in Table 1 also falls within this range.

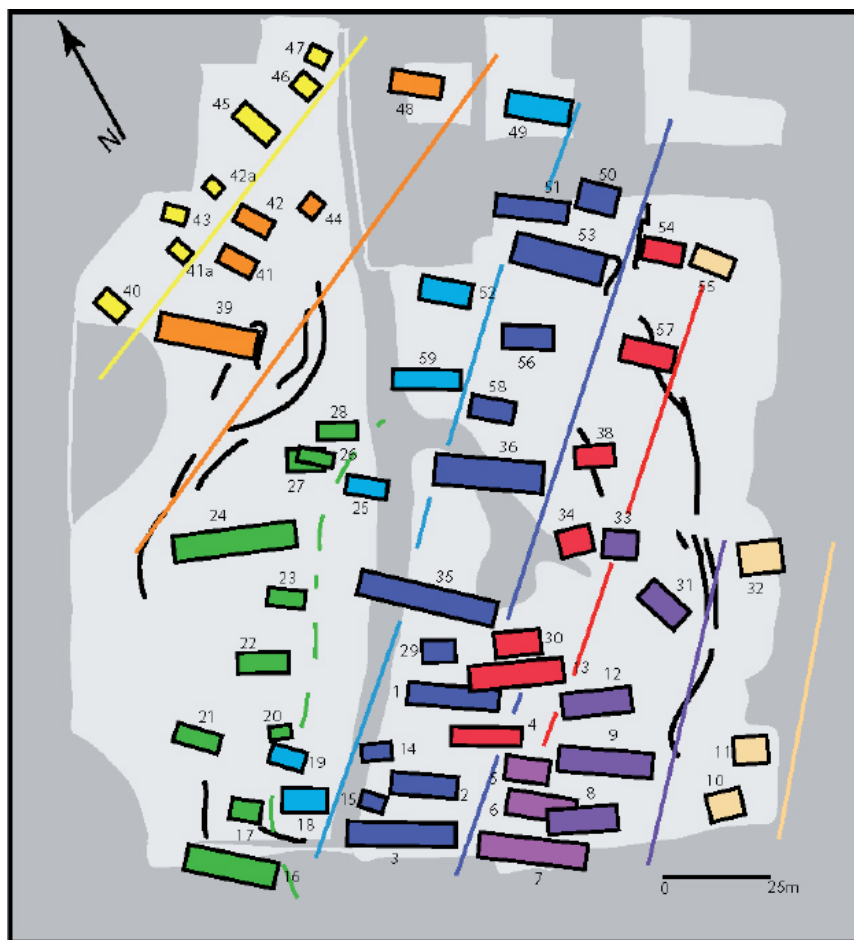


Figure 10. Geleen-Janskamperveld, Netherlands. Houses of the same colour seem to form rows. The boundary between the cream and purple rows corresponds with a ditch. Type 1 houses are spread in different rows. After Louwe Kooijmans et al. 2003, 376, fig. 2.



Figure 11. Geleen-Janskamperveld. Dashed lines are the wards reconstructed by Louwe Kooijmans et al. (2003). The houses which the authors have dated to ceramic phase 3 are shown in black. As seen in figure 10, they form a line. After Louwe Kooijmans et al. 2003, 387, fig. 8.

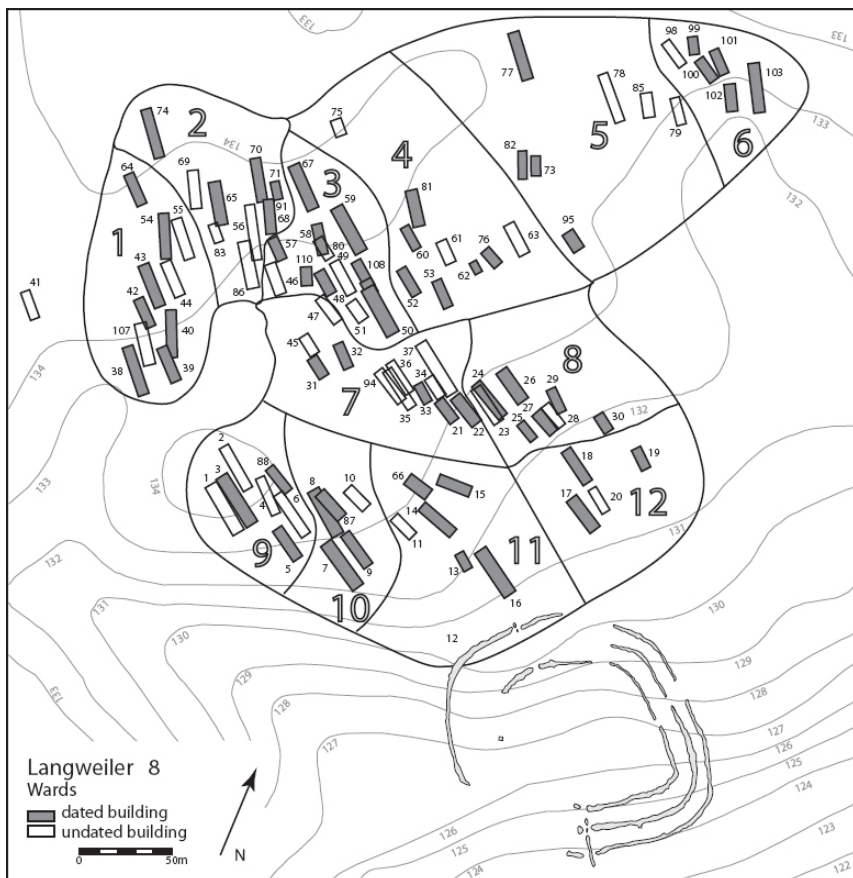


Figure 12. Langweiler 8, Rhineland. Diachronic structure of wards 1–12, illustrating the Hofplatzmodell. The suggested ward boundaries seem artificial. After Stehli 1994, 87, fig. 1.

LBK climate

This begs the question of why slope locations were preferred. According to new dendro-climatological investigations, above-average rainfall could be reconstructed for the LBK (Schmidt *et al.* 2004). Alongside results from dendrochronology (Figure 15), the following observations support the idea of a moist and warm climate during the LBK:

- 1.The formation of large lime deposits, for instance in Stuttgart-Bad Cannstatt, Baden-Württemberg (Wagner 1995, 24–25) and Wittislingen, Bavaria (Stirn 1964, 76; Seitz 1990, 20f).
- 2.The occurrence of the pond turtle¹⁹ in central and northern Europe (Willms 2003).
- 3.Kreuz (2007) discusses the dominance of two-grained einkorn over emmer in the

LBK as a possible climatic indicator. For several reasons, einkorn is the worse choice. Its only advantage over emmer is that plants remain upright in heavy rainfall and do not lie down, as all other cereal species, thereby avoiding substantial harvest losses. Interestingly, from the Flomborn phase onwards, which according to Schmidt *et al.* (2004) correlates with a rise in precipitation, an einkorn species which produces two grains per spikelet appears (Kreuz and Boenke 2003, 233ff).



Figure 13. Langweiler 8 as a row settlement. Rows seem to correspond well with contour lines shown in Figure 12. Over time, houses were added, decayed or were built over; this dynamic situation resulted in shifts within rows and of the rows themselves. Nevertheless, most houses fall within the suggested row boundaries. After Stehli 1994, 87, fig. 1.

Climatic factors seem to have played a large role in the selection of locations for settlements and have led people to build on slopes and to avoid areas at risk of flooding. Sielmann (1971, 101) noted that the areas in the top third of a rise or at a terrace edge are the zone characterised by the greatest soil aridity. This shows

that flat, badly drained areas on (high-lying) plateaux were generally too wet for settlement.

The measurements summarised in Table 1 show that height differences of a metre or more over 20–40 m long houses were frequent. If LBK houses had been directly constructed on the ground surface, the living floor would also be sloping. This can almost certainly be excluded. There are no known ethnographic parallels for dwellings with a sloping floor. If we hence assume a level floor, a possibility for reconstruction is to see the LBK house as raised partially or entirely above ground by posts. Building houses with an elevated dwelling platform would not have presented a great difficulty to Neolithic builders. Since the excavation of the LBK well from Erkelenz-Kückhoven in 1990, we have detailed knowledge of the highly developed carpentry skills of the time (Weiner 1995). On the basis of the know-how revealed there, it is certainly appropriate to base further reflections on the existence of well-developed house constructions.²⁰

Table 1. Slope gradient for 14 LBK sites. Calculations are based on site plans and topographical maps. Slopes fluctuate between 1.8 and 8.7%. Most LBK houses in the area are oriented NW–SE; the few exceptions are not considered here. All sites are located no more than 400 m from a watercourse. Note that for Ulm-Eggingen, the former ground surface has been radically altered due to gravel extraction (Kind 1989, 23); it is likely to have been steeper originally.

Site	Gradient (in %)	1.0 m height difference over a distance of	Direction of slope	Reference
Sallmannsberg	6.3 – 8.7	15.9–11.5 m	S	Brink-Kloke 1992, 9
Hienheim	4.8	20.8 m	SE	Modderman 1977, plate 3
Utzwingen	5.0	20.0 m	SE	Rück 2001, 18
Wittislingen	2.8	35.7 m	SE	Rück 1999, 8
Ulm-Eggingen	2.3	43.4 m	SE	Kind 1989, 23 and Beilage 1
Diemarden	4.8	20.8 m	SE	Posselt and Saile 2003, 312, fig. 3
Hempler	3.0	33.3 m	SSE	Schade-Lindig and Schwitalla 2003, 352
Köln-Lindenthal	2.5	40.0 m	SSE (north ring)	Büttler and Haberey 1936, plate 3
Langweiler 8	2.6 (near house 31) – 3.3 (near houses 1–9)	38.5–30.3 m	SE	Stehli 1994, 87
Langweiler 9	4.7 (near houses 8–11)	21.3 m	SE	Stehli 1994, 95
Langweiler 2	1.9 (near houses 8–11, 13, 14) – 3.6 (near houses 1–4)	27.7 m	SE	Stehli 1994, 90
Geleen	1.8 (minimum; data imprecise)	55.6 m	SE	Waterbolk 1958/59, 123, plate XVIII
Cuiry-lès-Chaudardes	ca. 2.5	40.0 m	SE	figures in Ilett 1982, 25–27
Mold	3.7	27.0 m	S	contours in Lenneis 2004, 383, fig. 4

Archaeological findings

Archaeological findings, too, support the position of LBK sites on slopes, as the following example of two buildings shows. Figure 16 illustrates the 35.8 m long house 12 from Ulm-Eggingen, oriented southeast-northwest. The plan is first of all

notable for the stepped profile, decreasing towards the southeast, of the two ca. 12.5 m long wall trench arms (Figure 17). In the western arm, the base of the northernmost post pipe (143/10) reaches an absolute height of 532.97 m above sea level. In contrast, the base of the southernmost post pipe (20/30) in the same wall trench arm is 0.40 m lower at 532.57 m above sea level. The situation is similar in the eastern arm of the wall trench. But the heights do not only decrease in the northwest part of the house. Over the entire length of the structure, the absolute heights of post bases decrease generally speaking from the northwest to the southeast (Kind 1989, 47). These different depths are not an isolated example; the same pattern is repeated in further structures, such as houses 8 and 10 at Ulm-Eggingen (Kind 1989), and houses S02, S07, S08, S11 and S13 at Landshut-Sallmannsberg (Brink-Kloke 1992). At the latter settlement, houses S02 and S04 have a stepped wall trench (Brink-Kloke 1992). Several buildings from Hienheim (such as houses 8, 17 and 29) show a comparable pattern (Modderman 1977), if one takes into account the ground level, left out of the schematic section drawings.

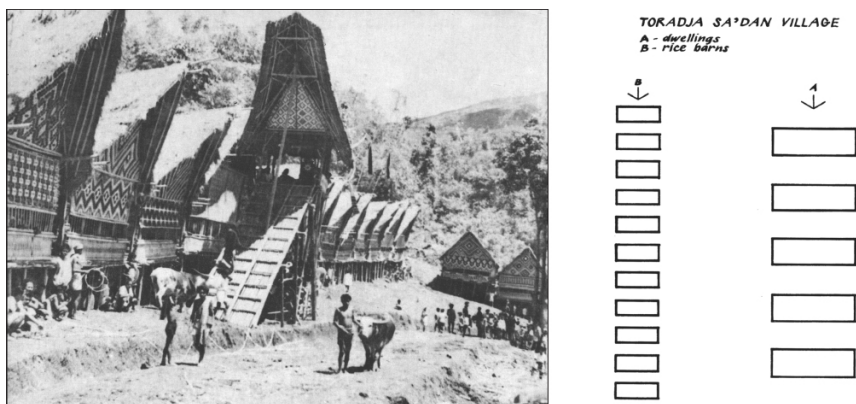


Figure 14. The Sa'dan settlement of the Toraja in central Sulawesi, Indonesia. Right: schematic layout. Fraser 1968, fig. 38 and 39.

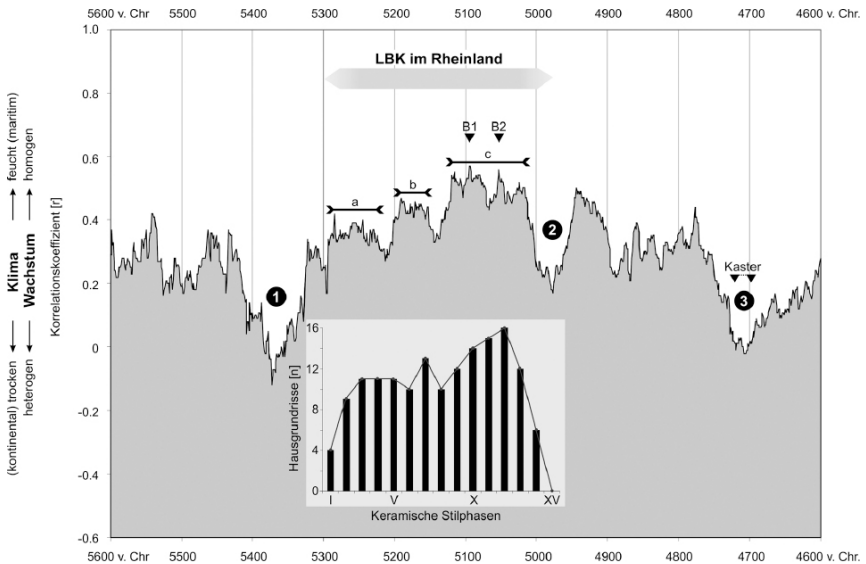


Figure 15. Reconstruction of rainfall patterns between 5600–4600 cal BC. After an extremely dry period at 5360 cal BC (1), precipitation progressively increased (phases a–c). A renewed dry episode (2) coincides with the end of the LBK. Period (3) is based on data from Kaster, Kreis Bergheim, Nordrhein-Westfalen. Points B1 and B2 denote the dendrochronological dates for the Erkelenz-Kückhoven wells. The overlay diagram shows the chronological distribution of 154 LBK houses from the Aldenhovener Platte dated to ceramic phases. Settlement seems to correlate well with increasing rainfall. From Schmidt et al. 2004, 304, fig. 1.

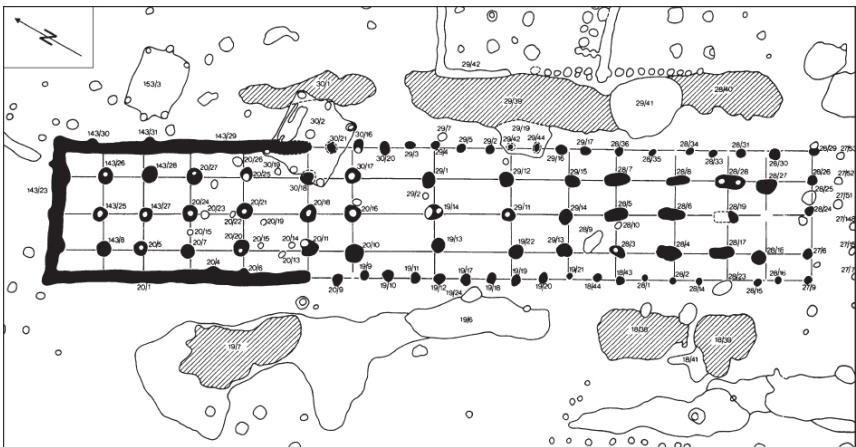


Figure 16. House 12, Ulm-Eggingen, Baden-Württemberg. Kind 1989, 49, fig. 25.

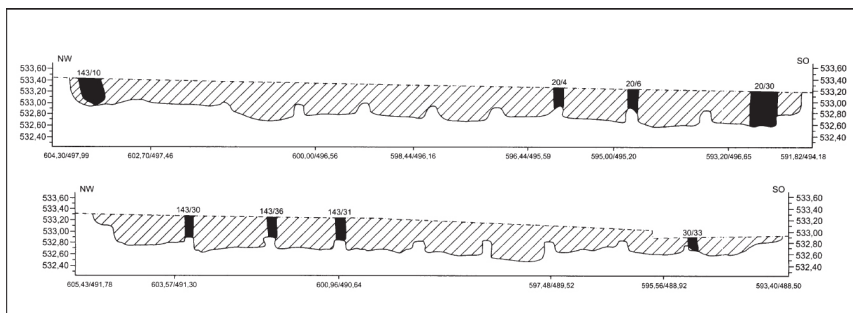


Figure 17. Ulm-Eggingen, house 12. Section through the western (top) and eastern (bottom) arm of the wall trench, showing stepped profile. Kind 1989, 49, fig. 26.

In the second example, house 1 from Mold in Lower Austria, the former slope is very clearly visible (Figure 18). The height measurements given on the plan (Lenneis 2004, 383, fig. 4) drop from 292.60 m above sea level in the preserved portion of the north part to 291.20 m above sea level at the southern gable end – a height difference of 1.40 m.²¹ As the postholes are of a roughly equal depth throughout the entire building, their bases in the southern end are consequently also 1.40 m deeper in absolute terms.

The archaeological examples collected here give the impression that the dominant slope was made use of in the course of house construction. As shown, in order to give sufficient stability to all posts within the house, their bottom ends had to be dug to a deeper level further down the slope, which resulted in stepped wall trenches and increasing depth measurements (Figures 17 and 18). At first, one could suppose that the posts in the southeastern or southern ends of the house were generally dug in deeper, but the findings from well-preserved buildings contradict this. In such cases, it is generally the posts in the northwest part which are the deepest, or the northwest and southeast posts reach the same depth below ground level. At Ulm-Eggingen, this is for instance the case with houses 2, 12 and 20 (Kind 1989); at Hienheim, similar observations were made for houses 2, 5, 8 and 31 (Modderman 1977).

The model of a dwelling platform

Bandkeramik houses on southeast facing slopes could be envisaged as follows: where a northwest part was present, it rested on the ground surface. In the central and southeast parts, depending on the slope gradient and the length of the house, the distance of a putative platform to the ground level would progressively increase (Figures 19 and 20). The central parts of LBK houses often contain posts which differ in diameter and depth from those in the northwest and southeast; they are larger and more deeply buried, as for instance in houses 14 and 17 at Hienheim (Modderman 1970, 25, 28), houses L02 and L05 at Lerchenhaid (Brink-Kloke 1992, 54, 58) or houses 3 and 18 at Weisweiler 111 (Rück 2007). In this part of the house, such posts generally seem to have been sufficient to carry the weight of the platform and the roof. However, the situation is different in the southeast part, where doubled post holes are found. Here, the height difference

between the ground and the platform was so large that a reinforcement was necessary for static reasons. A second, higher level (storage space) at this point of the house is also possible (Modderman 1970, 110). The presence of five internal post rows with double or triple post holes, as for instance observed in the *Großbau* at Mold, shows that the slope was integrated into the structure (Figure 18). This house is also notable for the presence of double and triple posts in the centre; here, there was already a height difference of 0.80 m.

Precipitation seems to have markedly increased in the course of the LBK and reached a maximum towards its end (Schmidt *et al.* 2004). In this case, the wall trench and the wall it supported may have had a protective function: to prevent surface water draining downslope from entering the northwest part and the space beneath the house. At the same time, the existence of a sturdy northwest part would have diminished the risk of the other house posts being destabilised by water. It is notable that towards the end of the LBK – and towards the end of the marked ‘wet phase c’ (Schmidt *et al.* 2004) – the wall trenches of houses were additionally strengthened. Archaeologically, this is manifest in the appearance of so-called protuberances (e.g. Modderman 1977, 28; Brink-Kloke 1992, 28, 58),²² i.e. additional posts on the outer side of the wall trench, which may have provided increased stability.²³

Buttler and Haberey (1936) suggested a further possibility for the reconstruction of an LBK building by proposing a platform entirely separated from the ground surface. *Kleinbauten*, too, could have been entirely supported by posts in this way (Figure 20, building in the background). The height above ground level of the dwelling platform can only be guessed at, but the space beneath a platform could only be used in a meaningful way if it was a metre high or more. The advantages of an elevated construction are clear: ground humidity is reduced and a storage space for wood, tools, or animals is gained. In addition, freely roaming animals are prevented from entering the structure and pests, too, are more easily kept at bay. There are several possibilities for reconstructing an LBK house. The varied examples of southeast Asia provide vivid parallels (e.g. Young 1974; Condominas 1974; Rousseau 1974; Stirn and van Ham 2000; Hasenbichler and Hanreich 2004).

Reflections on the durability of Bandkeramik houses

On the basis of his analysis of the excavations at Elsloo and Stein, Modderman (1970) assumed a use-life of 25 years for LBK buildings. Stehli reached the same conclusion in 1989. ¹⁴C analyses allowed LBK settlement in the Rhineland to be dated to 5300–4950 cal BC (Stehli 1989). Hence, the archaeologically established 14 settlement phases of the Aldenhovener Platte lasted a total of 350 years, resulting in an average length of 25 years per phase. These 25-year settlement phases have since been referred to as house generations (*Hausgenerationen*) and equated with the use-life of the buildings themselves (Stehli 1989).

This model has hardly been questioned since and has become well-established in LBK research. One exception is a recent article which attempts to evaluate the durability of LBK structures on the basis of findings from dendrochronology, wood biology, archaeology and historical building studies (Schmidt *et al.* 2005). The reflections and data collected there support the idea that prehistoric farmers and stockherders planned a use-life for their houses which went beyond the oft-quoted

25 years. The findings are briefly summarised in the following:

1. A field experiment on the durability of wood in different soil types, carried out in Great Britain, showed that 5 by 5 cm oak posts possess an average durability of 27 years (Purslow 1976; Purslow and Williams 1978; Smith and Orsler 1996). If this is transferred to LBK house posts, with their diameter of between 20 and 30 cm (e.g. Stieren 1951; Modderman 1970), we can calculate a use-life of ca. 100–160 years, as the durability of a wooden construction element in the ground is proportional to its diameter (Smith and Orsler 1996).
2. LBK buildings reconstructed in several open-air museums (e.g. Asparn an der Zaya, Austria, in 1970, or Oerlinghausen, Germany, in 1980) show no traces of decay on their wooden construction elements after several decades.
3. Economic considerations could support the idea that people attempted to use houses for as long as possible. The effort of building a Bandkeramik house (Startin 1978) is disproportionately larger than that for repairing it or adding parts. Thus, from the point of view of cost-benefit analysis, maintenance and enlargement should always be the preferred options (Lienau 2000).
4. There are now numerous known examples for repair/maintenance and for enlargements (additive building system).
5. The chronological difference between overlapping house plans was calculated for some Aldenhovener Platte sites (Table 2). The average time between a first and second build on the same spot is around 85 years (Schmidt *et al.* 2005). There seems to be a trend towards a 'long' use-life for LBK buildings (as a rough guess between 75 and 100 years). During his analysis of Elsloo and Stein, Modderman (1970) found only few instances of overlap. On the basis of datable pottery from pits near the houses, he suggested a clear chronological difference between the first and second builds.

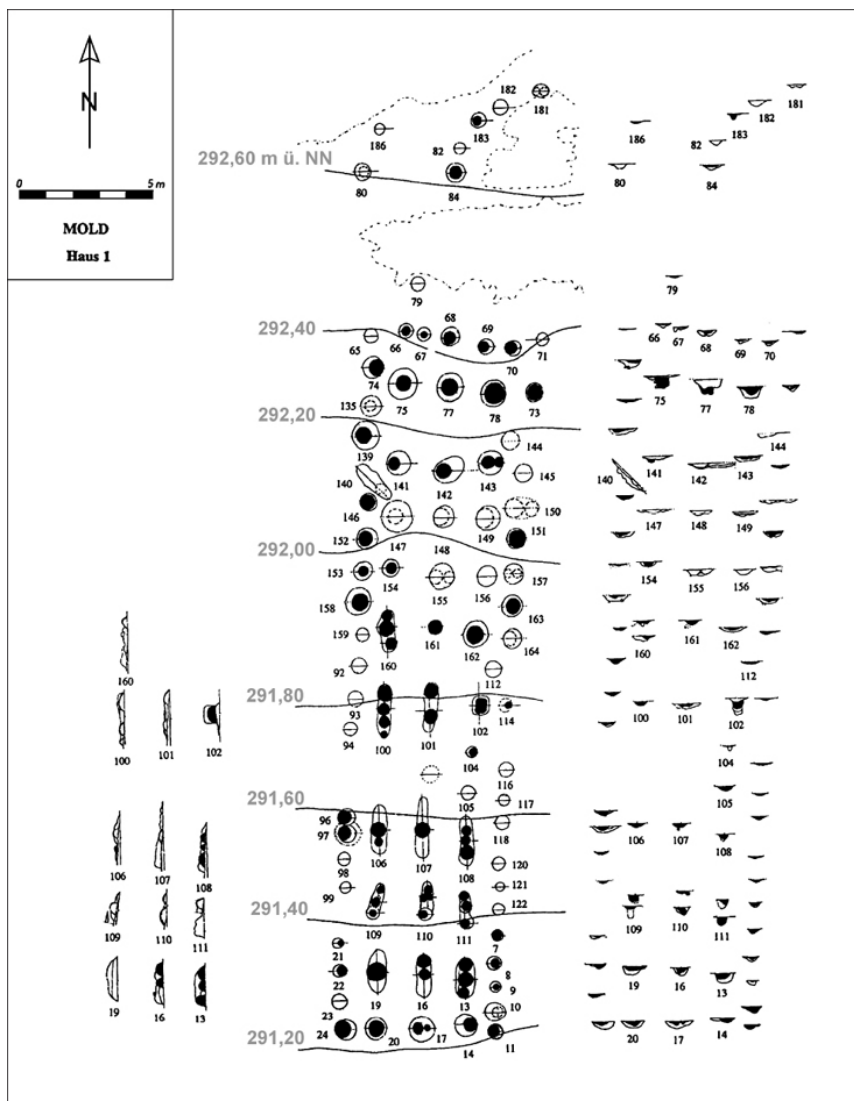


Figure 18. Mold, Lower Austria. House 1. Contour lines with highs above sea level (grey) show a difference of 1.40 m between northern and southern parts of the house, although post holes were equally well preserved throughout. Lenneis 2004, 383, fig. 4.

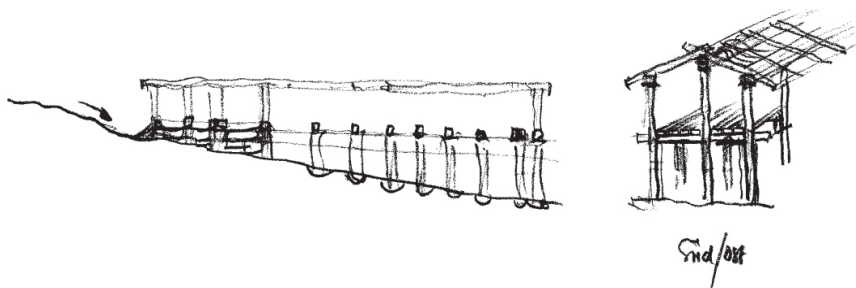


Figure 19. Sketch of possible reconstruction of a house built on a slope. Drawing by R. Mauss.



Figure 20. Garo longhouse, West Garo hills, India. Stirn and van Ham 2000, 62.





Figure 21. Southeast and central part of an LBK house upon excavation. The scale in the foreground on the right is 2 m long, showing the impressive dimensions of the building.
Kuper et al. 1975, frontispiece.

If the data on the durability of oak in the soil given in Schmidt *et al.* (2005) is summarised, an average of 100-125 years results. The lower figure of 100 years is chosen as the basis for further calculations. Here, it should be pointed out that the postulated use-life of 25 years (e.g. Stehli 1989; Zimmermann 2003) is itself based on an arithmetical model. The *Hofplatzmodell* itself provides far fewer arguments

for its idea of short-lived houses and the resulting settlement structure than have been listed here in support for a 100-year use-life.

Number of inhabitants in Bandkeramik buildings

The part of an LBK house shown in Figure 21 makes the dimensions of these structures clear. Table 3 provides numerical data on the average area of a structure. The effort for constructing such a building is enormous and cannot be handled by only a few people. Where LBK houses are reconstructed, for instance, professional organisations such as the German *Technisches Hilfswerk* are often asked for support, as they provide the necessary personnel and modern machinery.

Table 2. Time difference between first and second builds in the same locations at the Aldenhovener Platte sites Langweiler 8, 2 and 16. The duration between rebuilds varies between 25 and 150 years, but most second builds take place 75–100 years after the first construction. The gaps of 25 or 50 years suggest that gaps in the settlement structure were closed quickly. Although the table is only based on 11 overlaps, a trend towards a different use-life for houses (roughly between 75 and 100 years) is evident. Data from Boelicke et al. 1988, Stehli 1994 and Münch 1999; table from Schmidt et al. 2005, 158, tab. 4.

Site	House number older / younger	Phase older house	Phase younger house	phase difference	time difference in years
LW 8	58 / 80	VI	X	4	100
LW 8	8 / 87	X	XIV	4	100
LW 8	5 / 108	V	VII	2	50
LW 8	68 / 70	IV	VII	3	75
LW 8	68 / 57	IV	VIII	4	100
LW 8	91 / 70	I	VII	6	150
LW 8	9 / 87	XIII	XIV	1	25
LW 8	40 / 39	II	VII	5	125
LW 2	3 / 4	X	XIII	3	75
LW 2	15 / 16	IX	XII	3	75
LW 16	2 / 3	IV	VI	2	50

Table 3. Comparison of Langweiler 8 with 13 sites on the eastern Aldenhovener Platte. Calculations for Langweiler 8 are based on von Brandt (1988). Note that using only the 25 complete house plans at the site (von Brandt 1988, 179, 199) would result in an average area of 140 m² per house. Thus, the total built-over area may be up to 30% greater than calculated here. The other 13 settlements are treated together; the lower average house area of 87 m² is due to different preservation and recovery conditions.

Table from Schmidt et al. 2005, 158, tab. 3.

<i>Site</i>	<i>Number of houses</i>	<i>Total area of all houses [m²]</i>	<i>Average area per house [m²]</i>
Langweiler 8	108	11000	102
Langweiler 2	230	20000	87
Langweiler 9			
Langweiler 16			
Niedermerz 4			
Laurenzberg 7			
Laurenzberg 8			
Aldenhoven 3			
Lamersdorf 2			
Weisweiler 6			
Weisweiler 17			
Weisweiler 29			
Weisweiler 110			
Weisweiler 111			
Lohn 3			

With this in mind, it is hard to comprehend why the ‘magic number’ of ten inhabitants per house is so rarely exceeded in LBK research. Lünig and Stehli (1989) for instance assume only an average of 6.25 inhabitants per house. Zimmermann (2003) suggests seven and refers to ethnographic observations, but without specifying these more clearly. However, it is precisely ethnographic and historical data which furnish a completely different picture. Wherever the longhouse is the primary dwelling unit, there is a much higher number of inhabitants than is generally postulated for LBK houses. This is as true for Iroquois longhouses with their division into several family compartments (e.g. Warrick 1984) as for the longhouse societies of southeast Asia (e.g. Guidoni 1976; Hirschberg 1988).

Meier-Arendt (1979) also assumes a larger number of inhabitants per house. “Given their size, one should assume that these Bandkeramik houses were not only the dwellings of a family or rather clan” (Meier-Arendt 1979, 62). Following these estimates, one could suggest that 30 people or more lived under one roof.

Conclusion

In sum, in spite of the large number of LBK houses so far excavated, we can still not be certain of the appearance and use of these structures, nor of the way in which they were arranged relative to each other. To some extent, this is due to the over-reliance on very few models, mostly developed for sites in the Rhineland and subsequently uncritically accepted as facts. While immensely fruitful as heuristic devices, they have created a sense of security and familiarity regarding LBK buildings and settlement structure, and this has hindered the search for alternative explanations of our data. The most prominent example is the *Hofplatzmodell*, hugely influential in the reconstruction of LBK social structure as a whole, which postulates a short use-life of houses and a large distance between contemporary buildings. However, the criticism also applies to the reconstruction of the above-ground features of houses, where alternative possibilities have so far been little discussed.

The present article has outlined several ways in which these assumptions can be challenged. It is argued on the basis of house repairs and the qualities of sturdy

construction timbers that houses may have stood for as long as 100 years, which has profound implications for the structure of settlements and the number of inhabitants at any given time. On several sites, it has been possible to suggest an ordered settlement layout of rows of houses with parallel gable ends (*Zeilensiedlungsmodell*). In this model, contemporary houses are close to each other and the traditional idea of independent wards is strongly relativised. In addition, the pronounced slopes on which LBK houses were built, probably to respond to climatic factors, should be taken into account in reconstruction attempts. One possibility is the presence of a raised living platform in parts or all of the building.

Translation by Daniela Hofmann

Notes

¹ Architectural variation is clearly reflected in the diversity of house plans.

² A differentiation of regional groups on the basis of ceramic decoration was already carried out at the beginning of the last century (e.g. Lehner 1912; Koehl 1914; Bremer 1925).

³ The northwest part of this building is also incompletely preserved. Seen in its entirety, the structure shows a remarkable pattern of post settings. It seems slightly bent and the northwest part appears to have been trapezoidal. One of the post rows in the central part consists of only two posts, while an unusual post setting also occurs in the southeast.

⁴ The pit is situated diagonally right in front of the southeast end of the structure and seems to reference the building. Usually, pits associated with the southeast part are at the long sides of a house. For unexplained reasons, in house 2 the interior double posts and the position of the pit have been rotated or offset by 90°.

⁵ To facilitate understanding, the indications and structures are here discussed for buildings oriented northwest/southeast, but they can analogously be transferred to houses with other orientations, e.g. north-south.

⁶ Socio-economic and social factors are postulated as the reason for different sizes and types of structure (Lienau 2000), but they require further discussion.

⁷ From socio-political and socio-economic points of view, the practical execution of a house enlargement would also be a simple means to react to changes.

⁸ In the German literature, the term *Wohnplatz* is used alongside *Hofplatz*.

⁹ There is one possible case of overlap. Houses 4 and 5 may partially overlap house 19. Due to the bad preservation of house 19, no certain conclusions can be drawn; but given the overall situation, an overlap seems unlikely.

¹⁰ Whether consciously or not, this is probably the reason why on the plan for Cuiry-lès-Chaudardes (Figure 7) the house numbers were added parallel to the southeast end of the house.

¹¹ Quite apart from the architectural elaboration, the southeastern or southern end of a house would generally be a favourable place for activities due to its greater exposure to sunlight.

¹² A possible rule-of-thumb is that on large LBK sites, typologically distinct buildings are often offset, while morphologically similar houses are frequently parallel and have aligned gable ends. This is very clear at Straubing-Lerchenhaid (Brink-Kloke 1992).

¹³ This figure must be interpreted in relation to the average house length at a given site. In metres, depending on the settlement, a row of houses could have been between 25 and 50 m wide.

¹⁴ Langweiler 2 and 9, with five wards each, are among the settlement plans reproduced in Coudart (1993, 129, fig. 15).

¹⁵ The term 'village' is here used in a general sense to refer to a settlement of several houses

- and characterised by agricultural social and economic structures.
- 16 The prerequisite is that sites are carefully and completely excavated, a situation that is becoming ever rarer due to restricted funds.
 - 17 House reconstructions based on ethnographic parallels are so far rare in the archaeological literature (but see Buttler and Haberey 1936; Coudart 1998).
 - 18 [...] what I have since called 'paradigms'. These I take to be universally recognized scientific achievements that for a time provide model problems and solutions to a community of practitioners" (Kuhn 1996, X).
 - 19 Bones of the pond turtle (*emys orbicularis*) have been retrieved from the following sites (after Willms 2003, 190): Eilsleben (Döhle 1994), Erfurt-Gispersleben (Barthel and Cott 1977), Straubing-Lerchenhaid (Ziegler 1985/86), Paffigen (Stork 1993) and Brześć Kujawski and Strzelce (Bogucki 1982). The natural habitat of the pond turtle requires the constant presence of water and sufficiently high summer temperatures for several months, see http://www.swissherp.org/Swissreptiles/Emys_orbicularis.html. (accessed 09.03.2008).
 - 20 Given the usual dimensions of the posts of an LBK house (0.25–0.40 m; Stieren 1951, 66, fig. 3; Modderman 1970, plate 23), a multiplicity of reconstructions is possible on static grounds.
 - 21 This figure was probably even greater in Neolithic times, as the house most likely continued further to the north (Lenneis 2004, 383, fig. 4).
 - 22 Houses with strengthened wall trenches first appear at the end of the LBK (Modderman 1970, 109). This kind of wall trench construction becomes more frequent in the middle Neolithic (Großgartach, Stichbandkeramik, Rössen; see Hampel 1989, 81, fig. 67).
 - 23 The statics of load-bearing walls and their stability are discussed in Rapoport (1969, 124, fig. 5.27).

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A monumental prestige patchwork

Joachim Pechtl

Architecture is a striking element of the archaeological record of the Linearbandkeramik culture (LBK), the first Neolithic culture to be found in vast parts of central Europe during the second half of the 6th millennium BC. This is due to the fact that substantial building structures were erected using a construction technology based on substantial wooden posts (von Brandt 1988). Usually such postholes reached a minimum depth of about 1 m. Accordingly, the preservation of LBK features is often relatively good, at least compared to other prehistoric cultures within the same region. Therefore, archaeologists recognized LBK buildings as early as the 1930s, although they were initially partly misinterpreted as barns (Frickhinger 1933; Buttler and Haberey 1936). From this time onwards, great attention was paid to houses, especially in technological, typological, and economic respects (Buttler and Haberey 1936; von Brandt 1988; Coudart 1998; Hofmann 2006; Luley 1992; Modderman 1972; Rück 2007; Stäuble 2005; Stäuble and Lüning 1999). In this study, the monumental aspects and the spatial distribution of a certain group of exceptionally long houses are focused on and compared with those of enclosures, the second type of monumental architecture known from the LBK. Based on the revealed patterns, it is argued that the prestige connected with big houses or enclosures probably affected social groups of different size. Hence it is proposed that regions with varying levels of social integration can be identified.

Long houses and ostentation

Frequently, the existence of very large houses is pointed out, the same impressive ground plans are repeatedly shown, and often 'longhouses' are even claimed to be typical for the whole LBK (Hodder 1990, 116; Lüning 2005). This is only partly true; of course, houses with the enormous length of 30 m and more have been excavated, but they are rare, as can easily be shown. Since the architecture of the oldest LBK phase is somewhat distinct (Stäuble 2005), only houses from the Flomborn horizon onwards are considered here (phase II –V after Meier-Arendt 1966). An extensive database for this study is provided by Coudart (1998, 118–225), who gives the total length of 236 completely preserved ground plans from 41 sites all over the LBK territory. Since Coudart (1998) stresses western sites, 92 ground plans from larger excavations in southern Bavaria and Saxony were added to gain a better coverage (Brink-Kloke 1992; Burger-Segl 1998; Herren 2003;

Neumair 1992; Pechtl 2009; Rind 1994). Within these 328 houses, an enormous variability in length is apparent, ranging from 5.5 m minimum up to a maximum of 46.5 m (Figure 1). As the histogram shows, most houses reach between 10 and 20 m, a secondary maximum is found at about 22 to 28 m. The average length is 20.1 m and the median is 18.0 m. For this reason, the majority surely cannot be labelled as 'longhouses' in the strict sense of the word, since their dimensions are moderate.

Of course, the products of vernacular architecture are above all utilitarian objects, guided by the economic needs of the household group. Unfortunately, the internal patterns of use of LBK houses are badly understood. Three different types of elementary component can be clearly identified formally (Modderman 1972; von Brandt 1988). The 'middle part' is always present and may even form an independent house on its own ('type 3'). So-called 'northwest parts' are often added. Combined with only a middle part, this generates a 'type 2' house. Sometimes, an additional 'southeast part' can be found. Such tripartite ground plans are called 'type 1'. It appears that the middle part is the essential element and the focus of most social and economic activities. But so far, specific functions cannot be ascribed with certainty to either the northwest or to the southeast parts. Probably, the construction of northwest and southeast parts is not only due to purely functional or economic reasons, but also to social and cultural ones. On average, tripartite houses are longer than bipartite ones; however, there is high variability in each group. At Stephansposching in Lower Bavaria, for instance, the longest bipartite house reaches 31.1 m, while with 32.0 m the longest tripartite building is negligibly longer (Pechtl 2009).

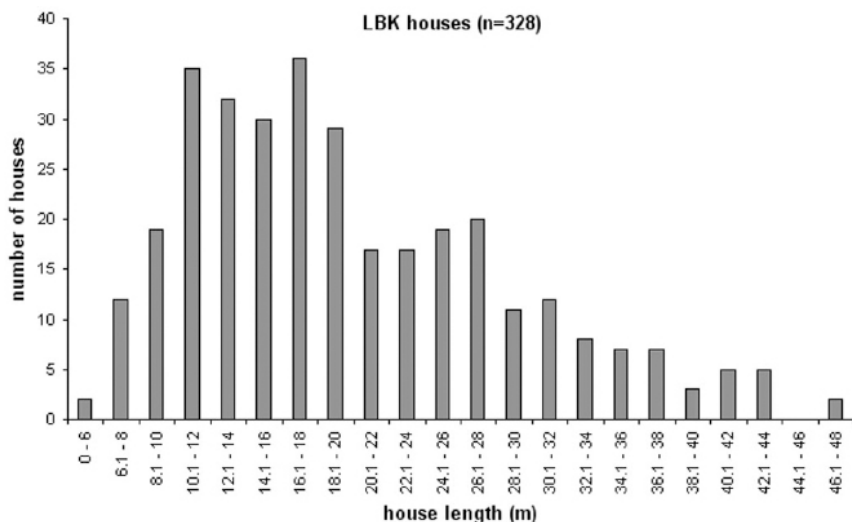


Figure 1. Length of 328 completely preserved ground plans from the entire LBK territory.

In addition to economic necessities, architecture can be more to people – and in the case of the LBK surely was. Houses as complex man-made structures are not

only capable of reflecting ideological and cosmological ideas, but due to their great importance in daily life and their high visibility they often tend to do so (Bollnow 1994, 123–24; Csikszentmihalyi and Rochberg-Halton 1989, 54, 137–38; Hodder 1990). Alongside the overall strong traditions of building, lasting more than 300 years, a very clear indication of this phenomenon in the LBK is, for instance, the strict orientation of the houses, presumably to the direction of the – imaginary – location of origin (Bradley 2001). Another sphere where architecture easily gains the character of a signal is the social domain. A building can become a statement of social networks, power, prestige, rank or status (Wilk 1983). In the case of the LBK, architecture was presumably of great importance in intercultural contacts. There is no doubt that contemporaneous, but culturally different communities still existed in close vicinity to LBK settlement regions, for instance late Mesolithic groups or the La Hogue culture (Kind 1997; Strien and Tillmann 2001). These obviously did not construct any kind of substantial buildings. In contrast, a central precondition for the Neolithic way of life was sedentism. Hence the spread of Neolithic culture in Europe was equalled with its ‘domestication’ (Hodder 1990). Regardless of the question of spread by migration or by acculturation of Mesolithic people, the LBK houses probably were a symbol of a certain lifestyle, especially in the perception of Mesolithic people. In contrast, people within the LBK community shared fundamental ideas, at least on a local scale. For that reason, houses were more likely considered as a medium of social competition (Hodder 1990, 118–29), since architecture provides excellent possibilities to display the economic, social or ritual strength of the household and thus to gain prestige.

Testing this theory is considerably constrained by the preservation of the archaeological record. Unfortunately, only ground plans are left and little is known about the design of the above-ground construction and its possible decoration, for instance by painting or carving. Archaeological discussion on functional and social significance mainly focused on ‘type 1a’-houses, a variant of tripartite houses with a foundation trench around their entire circumference (Kerig 2003, 238; Rück 2007). Beside this formal criterion, the dimension of a house, especially the length, might be the best available indicator for prestige ideology in LBK architecture. As the histogram of the length of 328 ground plans shows (Figure 1), no clear cut-off point can be observed in the frequency of different lengths. Therefore, no sharp distinction seems to have existed between what is – and maybe was – considered to be an extremely long house and the remainder of the buildings. Hence, an artificial borderline has to be drawn and arbitrarily the upper 10% of the dataset are chosen. So an extremely long house is defined as a structure exceeding 33.0 m in length.

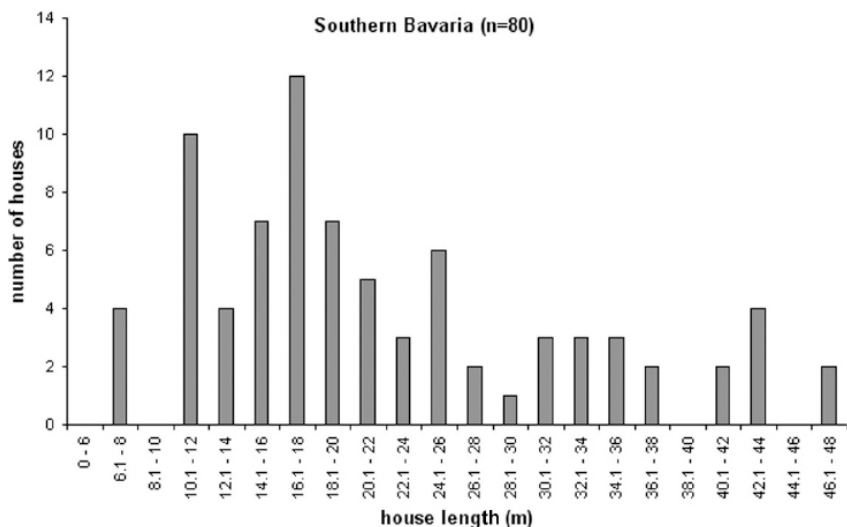


Figure 2. Length of 80 completely preserved ground plans from southern Bavaria.

Case study: southern Bavaria

However, it is methodologically questionable to begin with an investigation of the entire LBK territory, since significant regional divergences are to be expected. Instead, analyses on a local and regional scale have to be carried out first. Suitable conditions for such a project are found in southern Bavaria: several excavations of settlement sites yielding well-preserved ground plans have taken place and are adequately published (Brink-Kloke 1992; Burger-Segl 1998; Engelhardt *et al.* 1997; Herren 2003; Husty 1999; Modderman 1977; 1978; 1986; Neumair 1992; Pechtl 2009; Pfaffinger 1991; Rind 1994; Rück 2001; Schmotz 1997; Schmotz and Weber 2000). Among these are some large-scale investigations, which even allow us to discern local building patterns. Moreover, research was carried out in different parts of the settlement zones. Therefore, regional differences can also be established.

Among the different Bavarian loess zones settled in LBK times, the Gäuboden (see Figure 5) is by far the most important geographical unit. The Gäuboden basin is formed by the Danube valley between Regensburg and Pleinting and covers an area of roughly 80 km by 15 km. About 200 LBK sites are known in the Gäuboden, which are scattered densely along the banks of the Danube and its small tributaries (Reinecke 1982, 243 fig. 1; Hofmann 2006, 685 fig. A9.14). Smaller concentrations of LBK settlements are found in the middle Isar valley around Landshut, in several minor loess-covered basins along the upper Danube and in the Ries. The tertiary hills to the south and southeast of the Gäuboden are settled, but poorly explored.

Altogether, total house length could be determined for 80 ground plans, mainly from bigger excavations in southern Bavaria (Figure 2). The measurements range from 6.6 m to 46.5 m, the average is 22.0 m and the median is about 18.8 m. The distribution of values is principally similar to that in Figure 1. A large part of the houses measures 6 m to 30 m and approximately exhibits a Gaussian distribution.

The remainder of the longer houses, which are quite evenly scattered, follows without any clear-cut breaks.

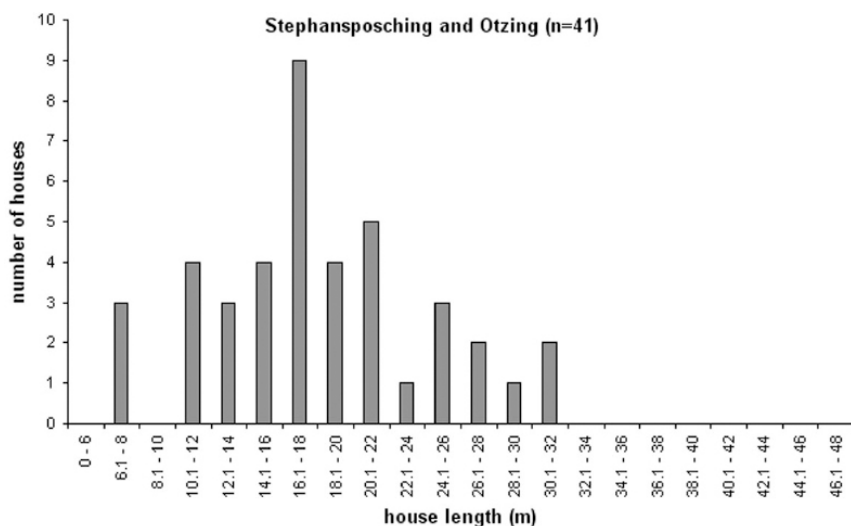


Figure 3. Length of 41 completely preserved ground plans from Stephansposching and Otzing (eastern part of southern Bavaria).

Mapping of the extremely long houses shows an obvious concentration of four sites in the western Gäuboden and the surrounding zones in the Regensburg area (Figure 5). Slightly further to the east is Straubing-Lerchenhaid, which perhaps can be added to this group. Another concentration of two sites is located in the middle Isar valley. No examples are known from the upper Danube valley or the eastern Gäuboden. Differences in the state of research can definitely be excluded as an explanation for this striking pattern: the most extensive excavations took place outside the distribution area of the extremely long houses, most notably in Hienheim, Stephansposching and Otzing. This is also the case when mapping another architectural feature typical of the LBK, the enclosures. Enclosures, like extremely long houses, can only be detected by extensive research strategies. In the region, enclosures are known from seven sites (Burger-Segl 1998; Schmotz 1997). A dense concentration of five sites is situated in the eastern Gäuboden around the confluence of Isar and Danube. Straubing-Lerchenhaid, where as many as three subsequent enclosures were documented, is again separated from the main concentration of sites, but may be added to this group. The only enclosure outside the eastern part of the Gäuboden was found in Lengfeld-Dantschermühle. There is hence a clear polarity between extremely long houses and enclosures. The former are exclusively found in the western part of the main settlement region in southern Bavaria (the Regensburg area and middle Isar valley), the latter predominantly in the eastern Gäuboden. The rare sites with enclosures in the west always also yielded extremely long houses. However, the two features mostly seem to exclude one another.

The simple presence or absence of extremely long houses is not the only

architectural difference within southern Bavaria. On the contrary, the patterns of length distributions in the western and eastern part show distinctive divergences. The two neighbouring sites of Stephansposching and Otzing in the east are the largest excavated settlements in the region as a whole. The lengths of 41 houses can be determined and fall within a relatively narrow range between 6.6 m and 32.0 m (Figure 3). The average is 18.1 m and the median 16.9 m. The frequency distribution roughly resembles a normal distribution with a maximum at 16.1–18.0 m. A vague secondary maximum at 24.1–32.0 m is recognizable, but not a single extremely long house is documented. Although both sites possessed enclosures, the houses are below average with regard to length. On the whole, it seems that no excessive emphasis was placed on differentiating houses by this attribute.

The pattern on the western sites stands in strong contrast to this. Since most excavations in this zone yielded fewer ground plans than sites in the east, data from Regensburg-Harting, Köfering, Straubing-Lerchenhaid and Sallmannsberg have to be combined. Overall, the total house length can be defined for only 30 buildings (Figure 4). The values range from 7.2 m to 46.5 m, with an average of 26.2 m and a median of 22.5 m. The results are tentative due to the small sample, but they certainly make the outline apparent. Two well-separated blocks with an almost even frequency distribution are visible. With a length between 7.2 m and 25.6 m, the first block corresponds well with the main group at Stephansposching and Otzing. But only 57% of the houses belong to this class. The second block includes houses from 32.5 m up to 46.5 m long, and so largely conforms to the arbitrary definition of extremely long houses. The gap between 25.6 m and 32.5 m is of great interest here. It provides strong evidence for two clearly distinguished house classes. Remarkably, the houses of the slightly separated second frequency maximum at Otzing and Stephansposching correspond exactly with this gap in the west. In conclusion, extremely long houses are numerous in some western sites and apparently are not only in contrast with the smaller houses within the same villages, but also with the largest houses of neighbouring settlements in the east.

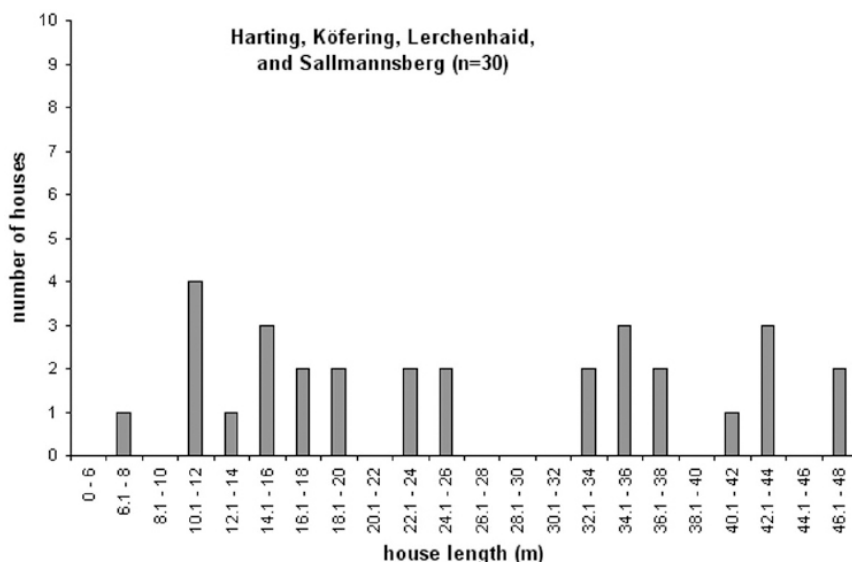


Figure 4. Length of 30 completely preserved ground plans from Regensburg-Harting, Köfering, Straubing-Lerchenhaid, and Landshut-Sallmannsberg (western part of southern Bavaria).

Altogether, 16 extremely long houses are known from southern Bavarian sites. Half of them were uncovered at the extensive settlement of Regensburg-Harting (houses 2, 9, 10, 12, 14, 16, 32 and 44: Herren 2003). Three such houses were found at the equally large site of Köfering (house 2: Matuschik 1991; houses 3 and 6: Brink-Kloke 1992, 22 fig. 2.4, 25 fig. 2.7). Only one house of this type could be documented in the middle to large settlements of Landshut-Sallmannsberg (house 2), Straubing-Lerchenhaid (house 5) and Murr (Brink-Kloke 1992, 42 fig. 2.24, 58 fig. 2.37; Neumair 1992, 14 fig. 2). Smaller settlements with such houses are Lengfeld-Dantschermühle and Mitterfecking (Burger-Segl 1998, 5 fig. 4; Rind 1994, 35 fig. 5). Thus, extremely long houses generally seem to occur on sites which were smaller than the settlements with enclosures in the east. Perhaps some of them even were isolated farms. As expected, most of these houses belong to the tripartite type 1 after Modderman's scheme. However, three ground plans do not show clear indications of a southeast part and are thus classified as the bipartite type 2 (Köfering 3, Harting 10 and probably 16). Chronologically, the earliest houses belong to the later Flomborn horizon, but most date to the youngest LBK phases (Herren 2003, 125 fig. 132, 157 fig. 179). It is all the more surprising that typologically old features are well represented even among the late houses, especially Y-arrangements and southeast parts with double posts (Harting houses 2, 32 and 44) (Figure 7). This might indicate that a notably conservative building style was connected with such huge constructions.

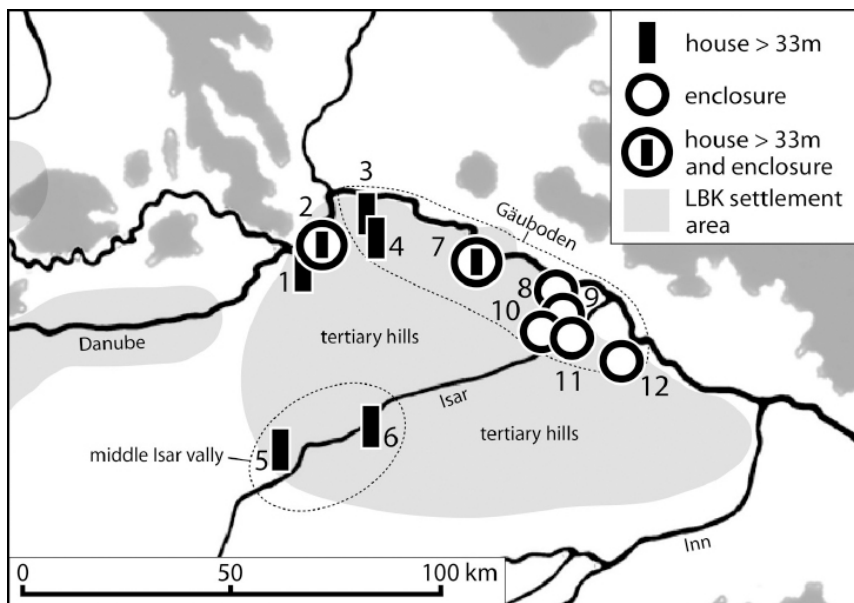


Figure 5. Distribution of LBK sites with extremely long houses (> 33.0 m) or enclosures in southern Bavaria. 1 = Mitterfecking, 2 = Lengfeld-Dantschermühle, 3 = Regensburg-Harting, 4 = Köfering, 5 = Murr, 6 = Landshut-Sallmannsberg, 7 = Straubing-Lerchenhaid, 8 = Stephansposching, 9 = Otzing, 10 = Wallersdorf, 11 = Niederpöding, 12 = Langenammung.

A wider perspective

Some of the traits established for southern Bavaria also hold true in other parts of the LBK territory. Especially the separation of extremely long houses and enclosures can be observed regularly (Figure 6). Extremely long houses could be identified at 31 sites (Appendix 1),¹ enclosures at 90 (Appendix 2).² The occurrence of both features at a single site is limited to four places. Except for the two southern Bavarian sites of Lengfeld-Dantschermühle and Straubing-Lerchenhaid, only the northern German site of Diemarden 1/Klein Lengden 6 and the western Hungarian Mosonszentmiklós are to be mentioned here (Saile and Posselt 2002; Egry 1997). It is noteworthy that the separation takes place at different scales: distinctions at the macro scale are very striking. For instance, in northern and eastern Bohemia and Saxony long houses are found to the exclusion of enclosures, which is largely true also for the western Weinviertel in Austria. The opposite is true for Upper Austria, the eastern Weinviertel, Moravia and western Hungary, where only enclosures exist. There is also a concentration of long houses in the western area of southern Bavaria, while only enclosures are reported from Baden-Württemberg. On the meso-scale of adjacent sub-regions, similar patterns of the exclusive occurrence of either one or the other feature can be observed in Franconia, Hesse, southern Lower Saxony or in the upper Danube/Ries region. Interestingly, this pattern is present even at the micro scale of single settlement

cells. For instance, in the intensively studied Merzbachtal on the Aldenhovener Platte, enclosures are known from the sites of Langweiler 3, Langweiler 8 and Langweiler 9 (Kaufmann 1997, 53–56; Lüning 1988, 157). None of the 125 houses at these sites conforms to the definition of extremely long houses. However, on the nearby site Langweiler 2 – without an enclosure – two of the 21 houses are longer than 33.1 m (Coudart 1998, 155–57).

Typological diversity and spatial boundaries

Similarly to southern Bavaria, two distinct traditions can be observed in many other regions: the building of either extremely long houses or enclosures. Their distribution is not evenly scattered or structured in great blocks, but resembles a patchwork-like mosaic. This impression is reinforced even more when two other aspects are taken into account. First, it has to be mentioned that in some important LBK regions neither of the two features exists at all, namely in central and western Bohemia or in Slovakia. At a medium spatial scale, this is also true for some smaller loess basins along the upper Danube west of the Regensburg area, for instance at Hienheim. Secondly, neither the extremely long houses nor the enclosures form typologically or functionally homogenous groups. Among the extremely long houses, there is enormous variation in length and typology. For example, both bipartite and tripartite houses are found in this class, alongside totally different proportions and designs for the northwest, middle and southeast parts, rectangular, trapezoidal or boat-shaped ground-plans, or walls built with single or double post rows. The longest LBK house known to date has been uncovered in Schwabhausen in Thuringia (Grasselt 2000). With a minimum length of 71 m, it is more than twice as long as the defined threshold for extremely long houses. Similar points can be made for the enclosures. Their outline might be rectangular, oval or irregular, there can be one to three ditches with V- or U-shaped profiles and their overall dimensions also show huge differences (Kaufmann 1997; Kerig 2003; Meyer 2003; Meyer and Raetzel-Fabian 2006, 3 fig. 1). An outstanding example for the typological as well as functional diversity of enclosures is the unique installation in Herxheim with its repeatedly re-cut pit alignments and the numerous deposits of ceramic vessels and human remains (Schmidt 2004; Zeeb-Lanz *et al.* 2006; this volume).

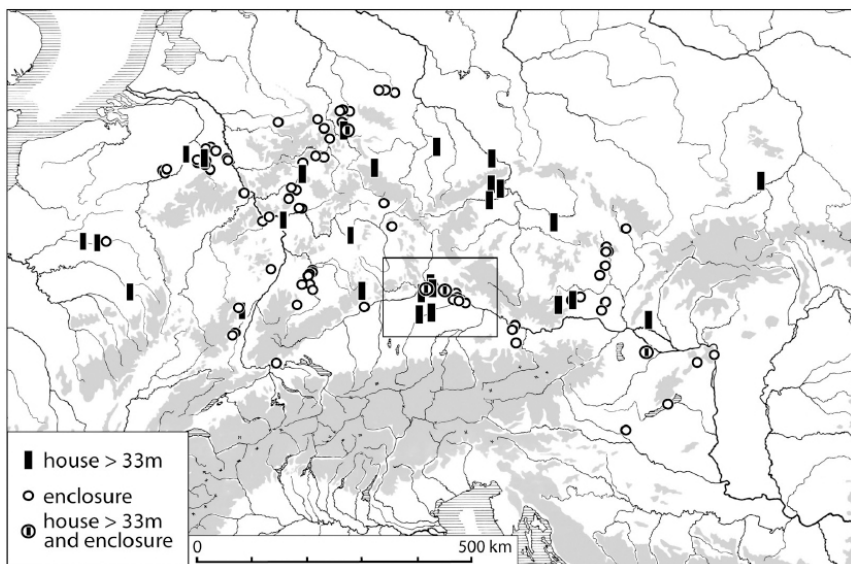


Figure 6. LBK-wide distribution of sites with extremely long houses (> 33.0 m) or enclosures. The rectangle delimits the area shown in Figure 5.

Analytically, the exact position of boundaries between groups is of great importance. In the southern Bavarian example, the frontier between the main concentrations of extremely long houses and enclosures is located somewhere between Regensburg and Straubing. Remarkably, it is not congruent with any topographical barrier, but rather divides the topographical unit of the Gäuboden plain. Similar relations seem, for instance, to exist in the Weinviertel. The otherwise topographically clearly separated regions of northern Bohemia and the Dresden area are linked by a comparable focus on extremely long houses. Interestingly, the same opposition between the western and the eastern part of the Gäuboden is also repeated with other attributes. For example, the distribution of underground ovens, preferred flint raw materials or some specific traits of ceramic decoration confirm this border (Pechtl 2009). Clearly, the geographical unit of the Gäuboden is socially and culturally divided. On the other hand, longdistance connections can be postulated: the enclosures of the eastern Gäuboden seem to be linked with those from the region of Upper Austria and western Hungary, further downstream along the Danube, as well as those in Moravia. And the extremely long houses of the Regensburg area show close connections to northern Bohemia and Saxony.

Discussion: constructing prestige

The construction of large houses and especially of enclosures requires a great investment of material and manpower (Kerig 2003, 238; Luley 1992, 54–59, 82–89; Pechtl 2006, 216–23). Cooperation of groups larger than single households is surely necessary and most probably manpower is a major limiting factor for the

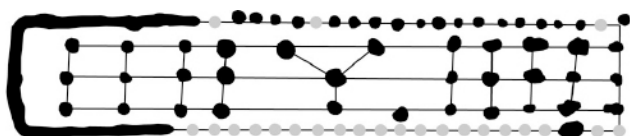
achieved size. Since the amount of available manpower is directly linked to the size and strength of the social networks involved, the highly visible outcome of such building activities can serve as token of the social status of the initiator. As already outlined concerning houses, this is one reason why architecture can be highly prestigious. As the above analysis shows, great attention was paid to the length of houses, at least at a local scale. It is hence highly probable that extremely long houses actually functioned as prestigious objects. The same argument probably holds true for the enclosures. Given this principal social mechanism, the typological and possibly functional diversity of both features does not matter. Only their structural similarity as prestige-bearing monumental signs is of importance for this study, so that supra-regional comparison is possible.

Interestingly, neither the houses nor the enclosures seem to have been intended to last for a long period. The houses mostly are thought to have been in use for only about 20 to 30 years (Lüning 2005, 153; critical: Schmidt *et al.* 2005). Despite the enormous investment in their construction, enclosures mostly do not show any signs of maintenance. At least the lower parts of ditches filled up quickly, and secondary use often took place within the ditches. For instance, burial pits were dug into the fills of the ditches in Vaihingen, Steinheim and Stephansposching, and underground ovens were sunk from the partly filled ditches in Vedrovice and again in Stephansposching (Krause 1997, 106–10; Dietrich and Kociumaka 2000; Pechtl 2009; Berkovec and Veselá 2004). Hence enclosures usually looked ‘new’ only for a few years. Instead of repairing existing ditches, new enclosures were sometimes built (Kaufmann 1997, 53 fig. 4, 63 fig. 11; Schmotz 1997, 132 fig. 9). Herxheim is a unique example of an enclosure with a long local tradition (Zeeb-Lanz *et al.* 2006). Nevertheless, it has to be mentioned that even ruinous enclosures were certainly visible for generations. Although their primary use may already have been abandoned, their function as a prestige-bearing monument might still have continued.

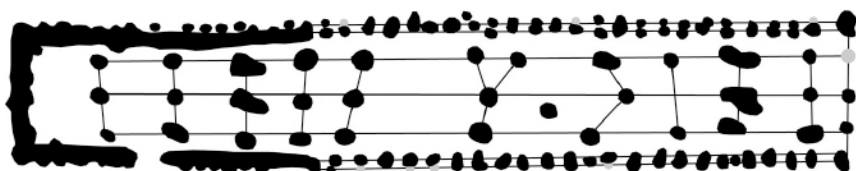
In the LBK, two fundamentally different possibilities existed for creating monumental structures: extremely long houses and enclosures. The important point is that monumentality – like wealth – is always defined in relative terms. In the emic perspective a roughly 20 m long house may have been considered ‘monumental’ by Mesolithic people, but surely not by the LBK farmers themselves. Thus it is necessary to know the specific cultural codes of a particular region in order to recognize elaborate houses. In the eastern Gäuboden, a length of about 26.0 m was probably regarded as big and prestigious, if not monumental. Some 40 km to the west, the same house would only have been considered normal. There, a tradition of constructing houses with exceptional dimensions existed, and these would have been regarded as really ‘monumental’ by nearly all LBK people.

The prestige gained through monumental architecture is usually ascribed to the owners or initiators. Therefore, the construction of an extremely long house apparently generated social prestige for the members of the household, and especially the household head. Since the digging of enclosures certainly required much more manpower than the construction of a house, the related prestige will have been ascribed either to the whole community of people involved or to the leader of a particular project. Hence, the choice between the two monumental types may be due to different levels of social integration. By constructing extremely long houses, more emphasis is put on the household group itself and

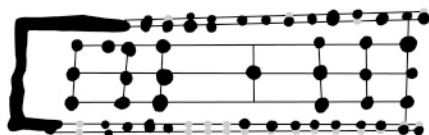
closely associated groups, such as neighbours or relatives. Competition obviously took place among different households even within a single settlement (Hofmann 2006, 115–18). Enclosures, in contrast, stress a higher level of social integration, such as clans, the whole village group or even a settlement cluster. Enclosures are often associated with sites that resemble central places (Kerig 2003, 231). The latter are for instance characterised by an early foundation date, long settlement continuity, greater settlement area, high building density, high amount and diversity of finds, developed exchange networks or a privileged access to raw materials (Saile 1998, 186–87; Kerig 2003, 236; Schade 2004, 21; critically: Petrasch 2003). Prestige competition carried out through enclosures occurred between different clans, villages or settlement clusters (Hofmann 2006, 131–35).



1: Gerlingen house 2



2: Regensburg-Harting house 2



3: Stephansposching house 82

0 33 m

 A horizontal scale bar with a double line, marked with '0' at the left end and '33 m' at the right end.

Figure 7. Comparison of the ground plans of three type 1 houses from southern Germany. 1: Gerlingen house 2, typical house from the Flomborn horizon with Y-arrangement and double posts in the southeast part, length = 31.4 m (after Neth 1999, 28 fig. 10). 2: Regensburg-Harting house 2, extremely long house from the latest LBK

with Y-arrangement and double posts in the southeast part, length = 42.7 m (after Herren 2003, 177). 3: Stephansposching house 82, typical house of the latest LBK without Y-arrangement and double posts in the southeast part, length = 20.5 m (after Pechtl 2009). Black: documented features, grey: reconstructed features.

This leads to the idea that in the regions in which extremely long houses occur, household groups and lineages were the primary level of identity. Probably a more or less egalitarian and segmentary society existed. Because of the weak stratification, personal and household prestige played a major role. Conversely, in the zones with enclosures one could expect a stronger social stratification with more differences in status and rank and a kind of central organization through Big Men or even chiefs (for basic social concepts: Sahllins 1963; for discussion on LBK sociology: van de Velde 1979; Kerig 2003, 231–39). Since single enclosures, at least their use in their primary function, are typically a short-lived phenomenon, they were possibly closely linked with the person who initiated the construction, not with a durable social institution. This fits better with the definition of a Big Man system. Following this idea, at least in some regions without any monumental structures there might have been either no need for such prestigious installations, or a lack of economic or human potential for constructing them. Cultural restrictions may also have existed. All this points to fairly egalitarian communities characterized by a minimum of social integration, perhaps mainly on the level of households which probably conformed largely to extended families. The striking geographical patchwork of the distribution of different monumental features thus indicates that certain differences of social organization can be postulated within the LBK. Again, Modderman's formulation of 'diversity in uniformity' for the LBK is confirmed (Modderman 1988). It seems clear that the different modes of monumental behaviour and their respective social organization competed with one another. People chose to follow one or the other way and sometimes voluntarily tried to establish boundaries to neighbouring communities.

Both types of monumental structure existed from the early LBK phases onwards and reach a peak in the latest phases (Kaufmann 1997, 48). The need for structures capable of demonstrating economic and social strength and the will to mark out social boundaries apparently increased towards the end of the LBK. This is interpreted as preceding the formation of tribal structures (Kerig 2003, 239). All the more, analyses of social structure need to take into account the historically unique situation of a certain site within its environment at a certain point in time. Hence, studies on the local and regional scale have to form the basis for larger-scale reflections. Inconsiderate comparison on a supra-regional scale will often mask clear distinctions instead of revealing them, since 'the' homogenous LBK is most likely a fiction of archaeologists.

Acknowledgements

Thanks to Dr. Daniela Hofmann, who invited me to contribute to this volume although I could not attend the Krakow conference. I would also like to thank Dr. Karl Schmotz (Kreisarchäologie Deggendorf) for kindly allowing me to study the excavation plans from Otzing and to use these data, as well as Thomas Link M.A. (Lehrstuhl für Vor- und Frühgeschichtliche Archäologie Würzburg) for providing

unpublished data from Dresden-Prohlis. My knowledge of some unpublished longhouses and enclosures is based on personal communications by Thomas Saile and Harald Stäuble, to whom I owe special thanks.

Notes

The unique construction form Bad Nauheim – Nieder Mörlen is not taken into account (Schade-Lindig and Schwitalla 2003), since its character as a residential house is not clear: the northwestern end of the somewhat peculiar ground plan of an approximately 37 m long house directly coincides with the trench of a circular palisade of 32 m diameter.

Most of the sites with enclosures are listed in Meyer and Raetzel-Fabian (2006, 8–9, Liste 1). For this reason, in Appendix 2, primary literature is mainly cited for typologically special enclosures or recent discoveries.

Appendix 1

List of LBK sites with extremely long houses (length > 33.0 m).

<i>Site nr.</i>	<i>Site</i>	<i>Minimum number of extremely long houses</i>	<i>Maximum length (m)</i>	<i>Date</i>	<i>References</i>
1	Bischoffsheim	7	41		Lefranc 2004, 56–57
2	Brezno	1	42.5	early LBK	Pleinerová and Pavlů 1979, 131
3	Buchbrunn	2	44	middle LBK	Hoppe 2001, 15 fig. 6
4	Bylany	3	45		Coudart 1998, 127–33
5	Čataj	1	34.6	middle LBK	Pavúk 1986, 368 fig. 2
6	Cuiry-Lès-Chaudardes	1	37.2	late LBK	Coudart 1998, 135–37
7	Diemarden 1/Klein Lengden 6	1	34		Saile and Posselt 2002, 34
8	Dresden-Mockritz	1	50	late LBK	Brestrich and Elburg 1996, 11 fig. 3
9	Ebsdorfergrund-Wittelsberg	2	42	middle LBK	Heiner 2006, 46 fig. 1 and 2
10	Eythra	1	55.9		H. Stäuble pers. comm.; Stäuble 2007, 30
11	Geleen	2	35		Coudart 1998, 145–46
12	Hrdlovka-Liptice	1	49	late LBK	Beneš 1991, 33 fig. 3, 45
13	Jetzelsdorf	1	41	late LBK	Ruß 2004, 752
14	Köfering	3	37		Brink-Kloke 1992, 69 tab. 2.1; Matuschik 1991
15	Landshut-Sallmannsberg	1	35		Brink-Kloke 1992, 69 tab. 2.1
16	Langweiler 2	2	39	late LBK	Coudart 1998, 155–57
17	Larzicourt	1	36.5	late LBK	Chertier 1980, 52, 53 fig. 4
18	Lengfeld-Dantschermühle	1	43.5	late LBK	Burger-Segl 1998, 3
19	Missy-sur-Aisne	1	33.5	late LBK	Coudart 1998, 169
20	Mitterfecking	1	42	late LBK	Rind 1994, 35
21	Mold	1	37.5	early LBK	Lenneis 2001, 106, 197 fig. 10
22	Mosonszentmiklós	1	41		Egry 1997, 104–05 fig. 4
23	Murr	1	33.9		Neumair 1992, 13
24	Nördlingen-Baldingen	3	43		Krahe 1988, 30
25	Olszanica	1	41.5	late LBK	Milisauskas 1986, 75
26	Postoloprty	1	41.3	middle LBK	Coudart 1998, 175
27	Regensburg-Harting	8	46.5	late LBK	Herren 2003, 175–85
28	Rosdorf	1	35.5	early LBK	Schlüter 1983, 56
29	Rüsselsheim-Schönau	3	48	early LBK	Göldner 2005, 37, 38 fig. 38
30	Schwabhausen	1	71	late LBK	Grasselt 2000, 49
31	Straubing-Lerchenhaid	1	37	middle LBK	Brink-Kloke 1992, 69 tab. 2.1

Appendix 2

List of LBK sites with enclosures.

Site nr.	Site	Minimum number of enclosures	Date	References
1	Asparn a.d Zaya-Schletz	2		Windl 2001
2	Bad Sassendorf	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 6
3	Bad Zwesten-Niederuff	2		Kneipp and Posselt 2005, 32-34
4	Balatonszárszó	1		Oross 2004, 11-12
5	Becsehely	2	early LBK/late LBK	Lüning 1988, 156-57; Kalicz 1984, 273-74
6	Bergheim-Gelsch	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 7
7	Bicske	1	late LBK	Makkay <i>et al.</i> 1996
8	Bietigheim-Bissingen	1		Krause 1997, 90
9	Borítov	1	late LBK	Berkovec and Čizmar 2001, 43
10	Bracht	1		Meyer and Raetzel-Fabian 2006, 9 Liste 1 nr. 41
11	Brackenheim-Hausen	1		Krause 1997, 90
12	Brackenheim-Meimsheim	1		Krause 1997, 90
13	Brno-Nový Liskovec	1	early LBK	Berkovec and Čizmar 2001, 43
14	Broichweiden	1		Meyer and Raetzel-Fabian 2006, 9 Liste 1 nr. 54
15	Budapest-Békásmegyer	1		Oross 2004, 67
16	Černá Hora	1		Berkovec and Čizmar 2001, 43
17	Colmar	1		Kaufmann 1997, 48
18	Darion	1	late LBK	Kaufmann 1997, 59 fig. 8
19	Dassensen	2		T. Saile pers. comm.
20	Diemarden 1/Klein Lengden 6	2		Saile and Posselt 2002, 28, 35; T. Saile pers. comm.
21	Eilsleben	2	early LBK/late LBK	Einicke 1994, 28
22	Eitzum	1		Einicke 1994, 28
23	Erkelenz-Küchhoven	2	late LBK	Kaufmann 1997, 57 fig. 7
24	Esbeck	1		Kaufmann 1997, 60 fig. 9
25	Frimmersdorf 1	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 18
26	Frimmersdorf 16	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 19
27	Gladebeck	1		Saile and Posselt 2004, 67 fig. 5
28	Grießen	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 29
29	Großeneder	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 9
30	Großrußbach-Weinsteig	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 20
31	Hanau-Mittelbuch	1	late LBK	Kerig 2003, 229 fig. 2
32	Hattenheim	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 14
33	Heilbronn-Klingenberg	1		Krause 1997, 90
34	Heilbronn-Neckargartach	3	middle LBK	Kaufmann 1997, 63 fig. 11
35	Herrenberg-Affstätt	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 1
36	Herxheim	1	early-late LBK	Schmidt 2004
37	Hofgeismar	1		Kneipp 2005, 81
38	Homburg-Wernswig	1		Kneipp 2005, 86 fig. 4
39	Hüttenberg-Hörsheim	1	late LBK	Christmann <i>et al.</i> 2007
40	Inden-Altdorf (WW 2001/107)	1	late LBK	Zimmermann <i>et al.</i> 2004, 58 fig. 7
41	Inden-Altdorf (WW 2002/12)	1		Zimmermann <i>et al.</i> 2004, 60 fig. 8
42	Jüchen-Hochneukirch	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 26
43	Kalefeld	1	late LBK	Geschwinde 2001
44	Köln-Lindenthal	3		Kaufmann 1997, 51 fig. 2

45	Köln-Müngersdorf	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 31
46	Lamersdorf 2	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 25
47	Langenammig	1		Schmotz 1997, 128–29
48	Langweiler 3	3		Kaufmann 1997, 53 fig. 4
49	Langweiler 8	1	late LBK	Kaufmann 1997, 55 fig. 5
50	Langweiler 9	1	late LBK	Kaufmann 1997, 56 fig. 6
51	Laufen am Neckar	1		Krause 1997, 90
52	Lautertal	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 32
53	Lengfeld-Dantschermühle	1		Burger-Segl 1998, 8 Beilage 1
54	Leonding	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 33
55	Menneville	1	late LBK	Lüning 1988, 157
56	Mosonszentmiklós	1		Oross 2004, 67
57	Niederpörling	1		Schmotz 1997, 123–41
58	Niedervellmar	1		Meyer and Raetzel-Fabian 2006, 9 Liste 1
59	Ober-Hörgern	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 35
60	Otzing	1		Schmotz 1997, 151–54
61	Plaidt	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 39
62	Pulkau	1		Meyer and Raetzel-Fabian 2006, 9 Liste 1 nr. 40
63	Rájec-Jestřebí	1	middle LBK	Berkovec and Čížmár 2001, 43
64	Rosenburg	1		Meyer and Raetzel-Fabian 2006, 9 Liste 1 nr. 42
65	Rosheim	1		Schmidt 2004, 334
66	Rutzing/Haid	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 21
67	Sarmsheim	1		Lüning 1988, 157
68	Schönecke-Büdesheim	1		Ramminger 2007
69	Schöneck-Kilianstädten	1	late LBK	Ramminger 2007
70	Schwaigern	1		Krause 1997, 90
71	Sondheim	1	early LBK	Schaich and Watzlawik 2004, 19 fig. 12
72	Steinbach	1		Windl 2001, 140
73	Steinheim	1		Dietrich and Kociumaka 2000, 33 fig. 22
74	Stephansposching	1	late LBK	Schmotz 1997, 141–51
75	Straubing-Lerchenhaid	3	middle LBK	Schmotz 1997, 129–38
76	Stuttgart-Mühlhausen	1		Krause 1997, 90
77	Sülebeck	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 13
78	Uničov	1	middle LBK	Berkovec and Čížmár 2001, 26 fig. 10
79	Usingen	1	late LBK	Laufer 2002
80	Vaihingen	1	early LBK	Krause 1997
81	Vaux-et-Borsset	1		Caspar <i>et al.</i> 1991, 79 fig. 1
82	Vedrovice	1	middle LBK	Berkovec and Čížmár 2001, 31 fig. 17
83	Wallersdorf	1		Schmotz 1997, 124–25; Faßbinder and Schmotz 1999
84	Waremmé-Longchamps	1		Bosquet 1993, 123
85	Weisweiler 17	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 16
86	Weisweiler 36	1		Meyer and Raetzel-Fabian 2006, 8 Liste 1 nr. 17
87	Wettolsheim	1		Kaufmann 1997, 48
88	Wetzlar-Dalheim	1	late LBK	Lorscheider and Schade-Lindig 2007
89	Wipfeld	1		Schaich and Watzlawik 2004, 27
90	Würselen	1		Meyer and Raetzel-Fabian 2006, 9 Liste 1 nr. 53

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The LBK settlement with pit enclosure at Herxheim near Landau (Palatinate). First results

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History of research at Herxheim

Between 1996 and 1999, excavations were conducted by the State Office for Archaeological Monuments at Speyer in the future trading estate 'West', on the edge of Herxheim (Südliche Weinstraße district, Palatinate) (Figure 1).¹ The focus of these investigations was a settlement area with surrounding double ditch belonging to the early Neolithic Linear Pottery culture (LBK) (Häußer 2001). In the course of excavation work, approximately one third of the settlement, situated within an apparently elliptical enclosure, was uncovered on the gentle southern slope of the newly emerging industrial estate. Only in the eastern half of the area were archaeological features less numerous. In this part of the site, intense intervals of erosion and the re-parcelling of agricultural land had led to the loss of the in-situ loess, which had become displaced and slid down the slope in a southeasterly direction. In contrast, in the northwestern part of the excavation, the removal of the topsoil revealed a dense concentration of archaeological features (Figure 2), among which the remains of several loam pits (*Längsgruben*) pointed to the presence of early Neolithic longhouses. Fortunately, at this point the site director Annemarie Häußer received additional support from a site technician kindly provided by the State Office for Archaeological Monuments. This made possible not only a particularly meticulous documentation of the excavation, but also permitted the realisation of numerous extra plana and the digging of additional sections through segments of the enclosure ditch, both of which would not otherwise have been possible given the short time period and financial limitations so often characteristic of the emergency excavation work undertaken by the State Office for Archaeological Monuments.

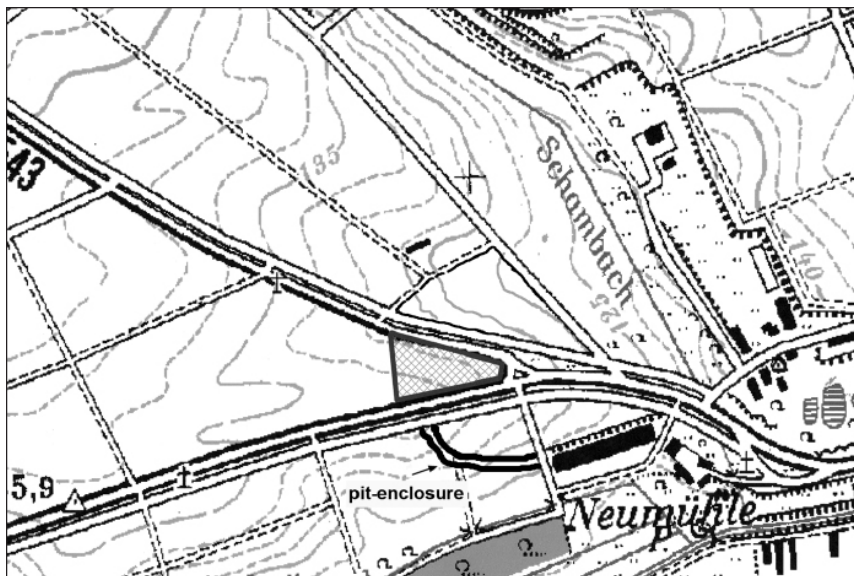


Figure 1. Location of the LBK pit enclosure and settlement in the future industrial estate 'West' (grey hatched area).

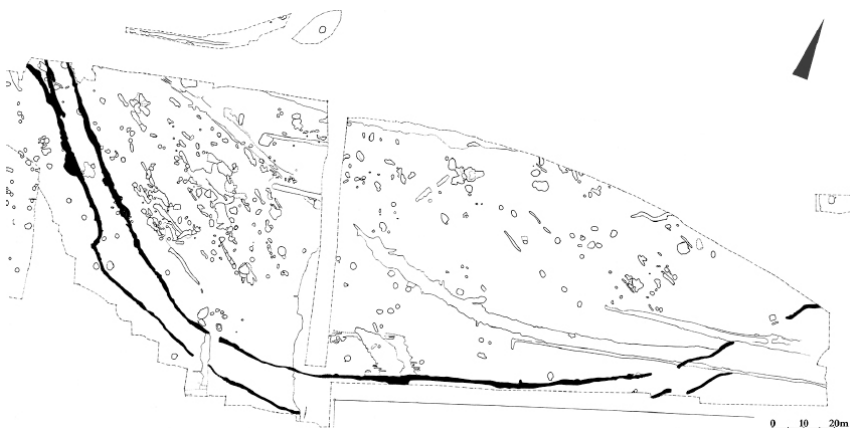


Figure 2. General plan of the excavations 1996–1999.



Figure 3. A concentration of several calottes in the inner pit enclosure ring.

It soon became evident from the excavation of the parallel enclosure ditches that this feature was exceptional and of a hitherto unknown type for the LBK. Between the upper planum and just above the base of the feature, numerous concentrations of human remains were discovered. Particularly conspicuous were regular concentrations of skulls comprising both complete skulls and, more often, meticulously prepared skull caps or a mixture of both (Figure 3). A further, equally remarkable characteristic of these skeletal deposits was the absence of complete skeletons. Instead, they comprised regularly mutilated torsos (Figure 4), truncated long bones, or parts of the spine, pelvis, and fragmented extremities; additionally, a conspicuously large amount of heavily fragmented bone material was recorded.

The incomplete skeletons, skull caps, and complete skulls were by no means isolated finds, but occurred together with a whole range of different artefacts, of which the most frequent is pottery. The latter is distinguished by its exceptional quality and good preservation. Additionally, there were bone implements, jewellery made from teeth and animal bone, stone beads, shells and snail shells. Flint and ground stone artefacts were also recovered. In several cases, even grinding stones were found within these placed deposits. It remains unresolved whether the regularly occurring faunal remains are representative of rituals or whether they stem from normal settlement refuse. Among the animal bones, those belonging to dogs are of particular importance and are discussed separately below. In addition to the manipulated human bones and skulls, nine regular LBK burials (flexed and extended) were observed. These were discovered either on the base of the ditches or, in four cases, as settlement burials in pits located within the enclosure. Thus, at Herxheim we have evidence of a sequence of both previously

known LBK settlement elements combined with an as yet unknown and unique series of deposits placed in the settlement's enclosure ditches.

In a catalogue accompanying a special exhibition, interpretations of this exceptional LBK site were already being made at a time when excavation was still in progress (Häußer 1998). In this publication, reference is made to the high quality decorated pottery recovered from the placed deposits in the ditches. On the basis of this material, the settlement was dated to the final LBK period. The same publication raised questions about what might have led to the accumulation of at least 450 individuals: 'war or peace'? In this respect, the proposition that an act of violence had led to the death of these individuals certainly gained the upper hand, particularly against the background of apparently similar finds, such as those at Schletz (Windl 1996; Wild *et al.* 2004) and Talheim (Wahl and König 1987); however, this occurred without a definitive verdict having ever been reached about the circumstances behind the features uncovered in the ditches at Herxheim (Spatz 1998).

After the tragic death of Annemarie Häußer, who was working on the pottery from the site as part of her Ph.D. thesis, the future processing of this material became uncertain, and the overall evaluation of this important site was suddenly in question. Nevertheless, the artefacts made of bone, antler and teeth (Haack 2001; 2002; 2003), as well as those of flint (Schimmelpfennig 2001), had already been presented in the form of M.A. dissertations, and faunal remains (Arbogast 2003) and botanical microfossils (Kreuz 2001) had already been evaluated. Furthermore, the systematic investigation of the enclosing parallel ditches had also already been undertaken by Katja Schmidt (Schmidt 2000; 2004a; 2004b), and isotopic analyses of some of the teeth from selected human individuals discovered in the ditches had been the subject of a further M.A. dissertation (Dürrwächter 2003). However, the financial means were lacking for the analysis of the pottery and the human bone material, the latter having only been briefly looked over for the purpose of preliminary reports. Both the human remains and the pottery represented key elements essential for the interpretation of the site.



Figure 4. Human torso in the inner pit enclosure ring.

Subsequently, Andrea Zeeb-Lanz, the responsible regional consultant at the State Office for Archaeological Monuments at Speyer, founded the 'Projekt Herxheim', the aim of which was to bring together a work group comprising both current and future scholars working on the various materials recovered from the site under the umbrella of a single project.² In this way, the meticulous treatment of the site could be guaranteed. Christian Jeunesse agreed to take over the evaluation of the pottery, and Zeeb-Lanz, with support from Jeunesse, Orschiedt, Haidle, and Schimmelpfennig, applied for funds from the DFG. The application was successful and funds subsequently granted for a two year period (2004/2005). The project is coordinated by the Office for Archaeological Monuments in Speyer, under the direction of Zeeb-Lanz.

Currently, the funding granted has made possible the digitalisation of the excavation plan by Fabian Haack, who, in the course of this process, is also undertaking an evaluation of the features from the settlement area – i.e. loam pits, settlement pits, slit-shaped pits (*Schlitzgruben*) and postholes – for inclusion in the final publication.

An important basis for the interpretation of the settlement at Herxheim is the doctoral dissertation on the earthwork submitted by Schmidt in 2000 (see also Schmidt 2004a). On the basis of observations made in the profiles and longitudinal sections, it could be demonstrated that the supposed ditches were not in fact continuous, i.e. dug in a single episode, but – as is evident in the longitudinal profiles – are composed of a series of overlapping, elongated pits with different depths. Additionally, the cross-sections are characterised by a wide variation of differently shaped profiles. Besides U-shaped, trough-shaped and V-shaped profiles, areas can also be discerned in which a U-shaped ditch floor is superimposed onto a V-shaped feature, which is indicative of the recurrent digging of new features (Figure 5). These features of the Herxheim ditches mean that they can be assigned to a pit enclosure (*Grubenanlage*) of the 'Rosheim'-type (Jeunesse 1996; Jeunesse

and Lefranc 1999). Characteristic of this type is the digging of individual, successive pits along a predetermined path. These pits remain open for an unspecified period of time, although they are also partly artificially refilled. The excavation of new pits follows along a line, probably made visible in some way on the surface, with the new pits being dug into either partially or completely filled older features (Figure 6). At the LBK site of Rosheim (Alsace), where a 'ditch' of this type was first encountered, gaps were sometimes observed between the individual pits. However, in Herxheim this is not the case. Presumably due to its longer period of use, with recurring excavation of new pits and their consequent refilling, the feature resembles a continuous ditch in the first planum. Meanwhile, the investigation of further early Neolithic earthworks by Schmidt has shown that the 'Rosheim'-type in fact occurs quite frequently in the LBK (Schmidt 2004b). Furthermore, evidence was found that a number of earlier excavated LBK 'ditches' can probably also be assigned to this type of feature. In these cases, the 'ditches' were usually only investigated using cross-sections, with the evidence for the 'Rosheim'-type hidden away in the unobserved longitudinal profiles.

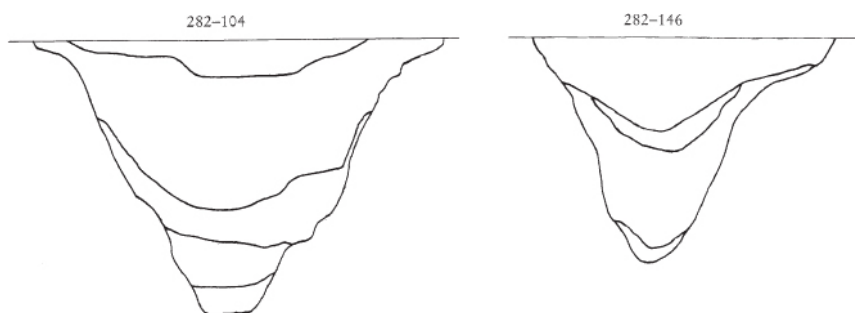


Figure 5. Cross-sections from the pit enclosure. The differing shapes of the bases from successive, overlapping features are easily distinguishable (scale 1:50; after Schmidt 2004a, fig. 10, 11).

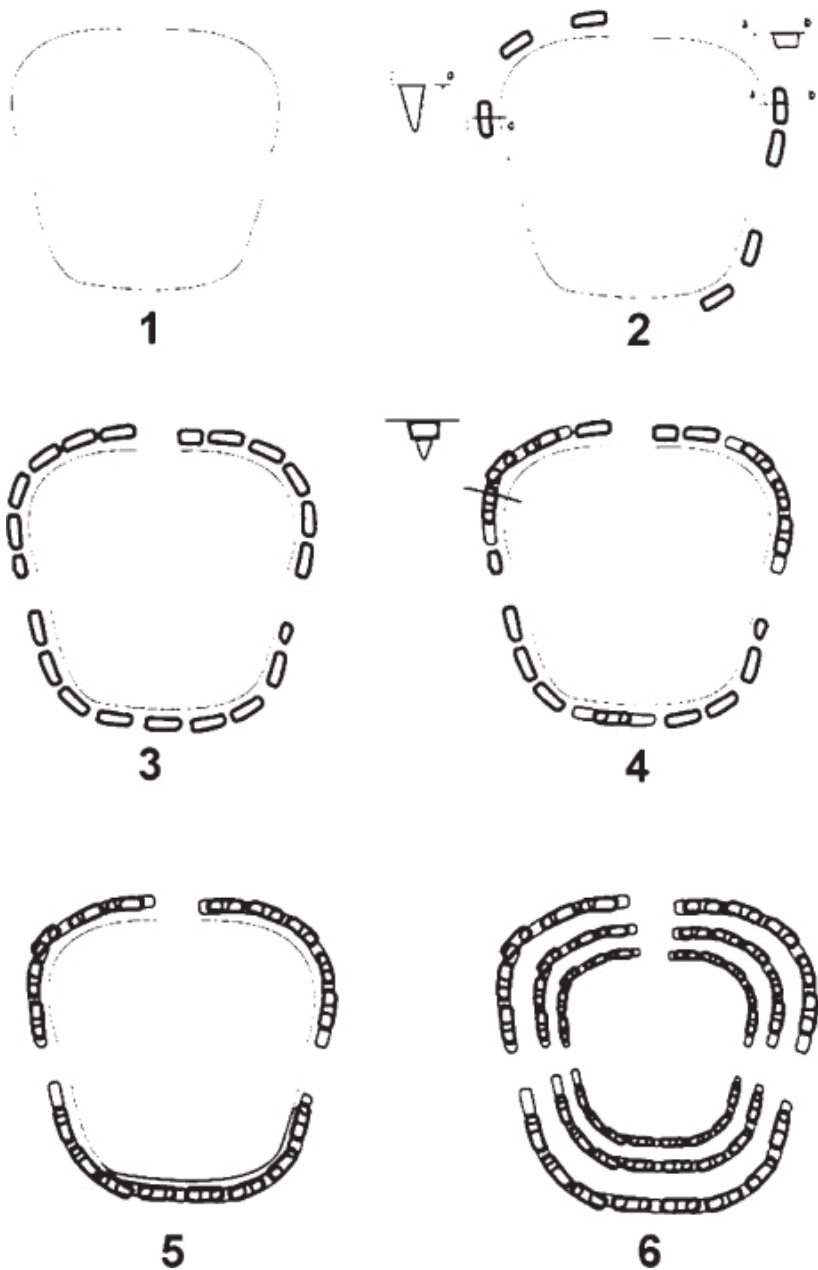


Figure 6. Model for the development of a pit enclosure ring around a settlement (after Jeunesse and Lefranc 1999, 53 fig. 30).

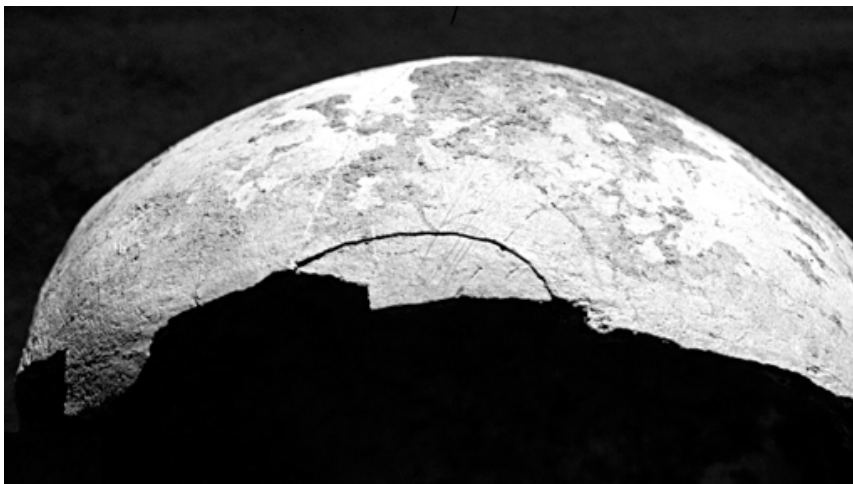


Figure 7. Cut marks on the side of a calotte.

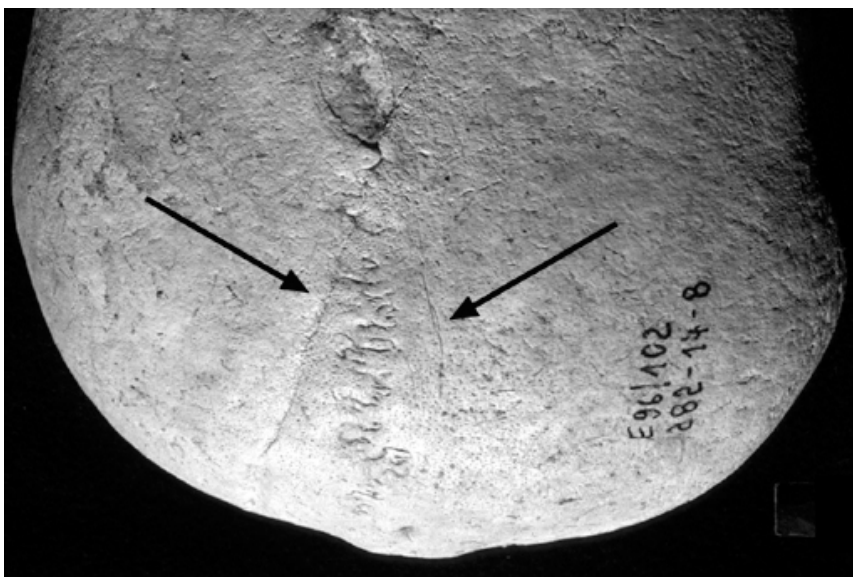


Figure 8. Example of a calotte with cut marks on the sagittal line and a healed injury (blow) to the head.

Human bone material

At present, thanks to DFG funding, the skeletal remains, with special emphasis on the observable signs of human manipulation, are being investigated at the Universities of Tübingen and Hamburg. First results from these analyses, conducted by Haidle and Orschiedt, have proved to be of far-reaching significance.

Up to now, c. 50% of the skeletal material has been anatomically recorded, identified, and individual findings evaluated. In earlier, preparatory work it was suggested that skeletal elements were systematically smashed (Häußer *et al.* 2006; Haidle and Orschiedt 2001; Orschiedt *et al.* 2003; Orschiedt 2006). This has since been confirmed not only for skulls, but also for long bones and other parts of the post-cranial skeleton. Currently, it can be assumed that at least 450 individuals of all age groups have been recovered from the excavated parts of the *Grubenanlage*, or pit enclosure. A definitive number can only be stated after the termination of evaluation work.

The modification of skull caps, which mostly display damage from blows to the foreheads and around the parietal bone, follows what can only be described as a standardised pattern. This involved about three blows to the forehead region and at least two to each side of the skull in order to detach its lower part. Additionally, around 10% of individuals show signs of cut marks along the sagittal line (Figure 7). These traces are mostly found parallel to the sagittal suture and in its extension across the frontal bone, as well as transverse to this direction below the *tuber parietalia* (Figure 8). In addition, analyses of fragments from the region of the lower forehead have shown that in isolated instances the scalp was cut obliquely directly above the orbits, after which the scalp, now cut into two halves owing to the prior incisions in the sagittal region, could be pulled off. Obviously, this was only a measure required for those individuals whose state of decay was less advanced. Probably, these were the remains of individuals who had only recently died. The patterns underlying the manner in which the skeletal remains were smashed could also be confirmed. Particularly evident was the very intensive working of long bones, the shafts of which are almost exclusively present in splintered form. Whereas the fragmentation of the long bones usually took place at a peri-mortal stage, in some cases older skeletal material was also treated in this manner. The evaluation of the skeletal remains also led to the identification, in a small number of individuals, of cut marks to the post-cranial elements of the skeleton. Soft tissue was detached from the shoulder blades, and elbow and hip joints had been severed. Therefore, manipulation of the entire human skeleton is conclusively demonstrated; previously, such practices had only been assumed for the skull and the lower jaw.

The placing of human remains in specific assemblages, their partial association with the remains of canidae, pottery, stone artefacts and other objects, as well as their standardised manipulation, all point to the performance of rituals. The earlier assumption that the site of Herxheim might provide evidence for conflict (Häußer 1998) is therefore invalidated. The extremely high number of individuals, which if projected onto the still unexcavated parts of the site gives reason to suspect a total of at least 1,350 persons, is a clear argument against conflict. This line of argument is also strengthened by the fact that despite the high level of fragmentation and the high degree of regular manipulation of the entire bone assemblage, there are no signs of traumatic injuries which might be interpreted as resulting in a violent death. Furthermore, the proportions of skeletal elements so far found at the site do not in any way reflect anatomical reality. For example, the remains of hands and feet are clearly underrepresented. Another argument which does not support the conflict hypothesis is that bones only rarely show signs of animal gnawing, which would be expected in the case of individuals killed in

conflict and initially left unburied. In addition to the lack of evidence for a battlefield scenario, there are no indications of malnutrition or nutritional deficiency from the skeletal material. Therefore, the human skeletal remains from Herxheim by no means provide evidence for an economical crisis or any other type of crisis scenario at the end of the LBK.

Flint artefacts

The 482 flint artefacts from Herxheim have been the subject of an M.A. thesis at the University of Cologne (Schimmelpfennig 2004). They constitute an atypical assemblage for the LBK, as they display some obvious peculiarities with regard to both raw materials and morphology. Flint artefacts were recorded according to the now commonly used system developed by Zimmermann (1988), which subsequently served as the basis for the identification of both local and distant regions and sites with equivalent flint materials (Figure 9).³

The analysis of the spatial distribution of flint artefacts at the Herxheim site has revealed that the inner 'ditch' clearly dominates, with 49.6% of artefacts found in this feature. The outer ring yielded just 16% and all remaining features a total of 33.6% of the analysed artefacts.

The identification of the raw materials and their origins can provide an important insight into Neolithic communication networks and has therefore constituted an integral part of the analyses. A total of 50% of the flint artefacts from the Herxheim settlement were made from high quality Cretaceous flints. Alongside the better known varieties of Rijckholt, Rullen and Lousberg, there are also pieces made of lesser known flint varieties, such as those from the Cretaceous units from the Paris basin. Types of flint similar to those discovered at Herxheim have also been identified, among other places, in the area of Rethel (départ. Ardennes, France) or Vertus (départ. Marne, France).

Evidence of contacts with the western part of Europe presumably includes the characteristic retouch observed on a transverse arrowhead (*Querschneider*), otherwise known from the Villeneuve-Saint-Germain und Blicquy groups (Plateaux 1990, 247 fig. 7.1–7.2). Furthermore, a number of pieces of Hesbaye flint were identified; some of these pieces originate from the Maastricht formation in the Belgium/Netherlands region. The group of so called 'Western Cretaceous flints', well represented with 12.2%, could originate from either the Netherlands, Belgium or France. In each case, the distance between Herxheim and the potential sources of these materials is around 250 km, and is therefore indicative of an extra-regional catchment area.

Large amounts of unspecific Jurassic and Muschelkalk chert have been recorded in the Herxheim assemblage. The former is found in the region of the Franconian Jura and/or the Swabian Alb, which begin around 110 km from Herxheim. Wittlinger (Jurassic) chert, the most important raw material during the LBK in the Neckar area, is also known at Herxheim, but is only poorly represented. Among the flint varieties found in the near vicinity are quartz and chalcedony, which although present in the Herxheim flint assemblage, are of the same very poor quality characteristic of Muschelkalk chert. Nevertheless, the latter was brought to Herxheim from distances of between 15 and 100 km.

As a whole, the raw material assemblage from Herxheim is characterised by very

diverse flint varieties of widely dispersed origins. Particularly interesting, however, is the preference for western and northwestern sources, which is in stark contradiction to the east and northeast oriented regional pottery groups observed in Herxheim during the final LBK. However, seeing as the flint artefacts stem from as yet undated features, a direct comparison cannot be attempted; at this point it should be stressed that the flint varieties from the site are representative of the entire duration of the settlement, which began in the Flomborn phase and lasted until the end of the LBK. Therefore, for the time being, whether the distinct differences in the origins of raw material and pottery traditions are actually attributable to different spheres of communication remains unresolved.

The analysis of blanks is of fundamental importance when interpreting the stone assemblage from any archaeological site. In combination with the amount of cortex, it provides information as to the condition of the raw materials upon arriving at the site, i.e. whether they were moved as nodules completely covered with cortex, as decorticated cores or as pre-fabricated blanks. The pattern underlying the exchange systems of raw materials during the LBK is understood at a relatively large scale (Zimmermann 1995), so that it should be possible to place Herxheim within an extra-regional exchange system, a contribution which might serve to further our understanding of the 'phenomenon Herxheim'. Regarding the flint distribution networks, LBK settlements generally fall into two categories. First, there are those undertaking blank production, situated in regions well supplied with raw materials, and second there are those situated in areas lacking sufficient raw materials, and which preferred to 'import' pre-fabricated blanks. The integration of the Herxheim settlement into this pattern is not without its difficulties; on the one hand, particular manifestations occur more frequently than at other sites, but on the other, forms we anticipated to find, such as unmodified blades, are significantly rarer. Consequently, the settlement at Herxheim cannot be assigned to an exactly delineated position between the two extremes defined above. However, it is quite certain that the high ratio of modified flakes in the flint assemblage is a reflection of a shortage of blades, a factor which compelled the population to turn increasingly to flakes for tool production. Furthermore, the rather rare occurrence of unmodified blades permits an evaluation of the entire spectrum as a regular settlement cross-section, which is not characterised by grave goods such as blades. Admittedly, as remarked upon above, this observation is limited; a final interpretation of the flint assemblage will only be possible when the artefacts have been correctly assigned to the individual phases of the settlement and its earthwork.

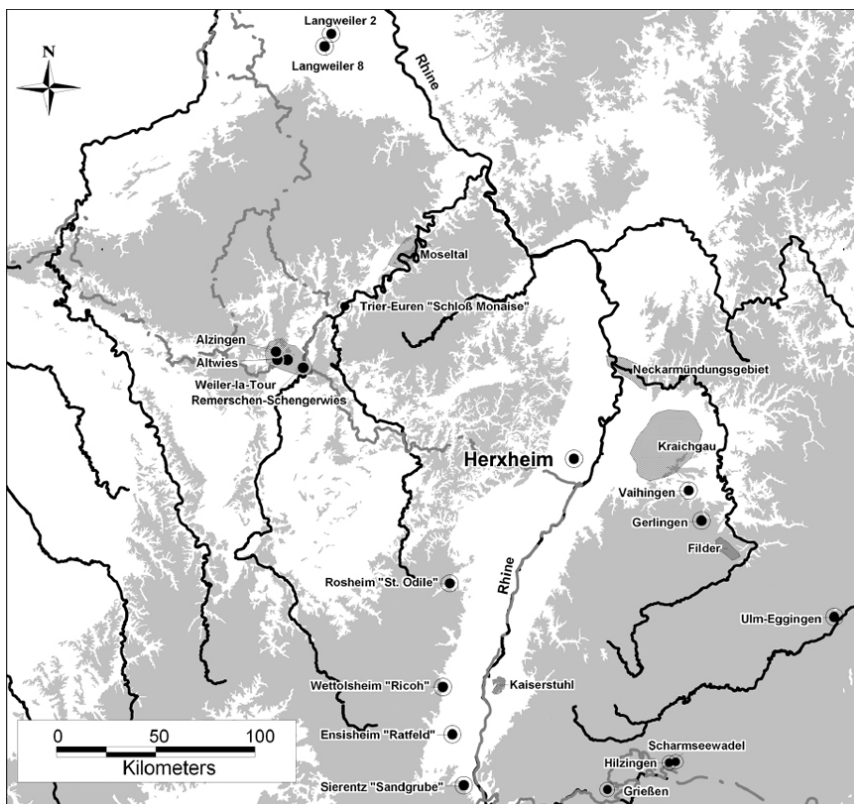


Figure 9. Location of the regions and sites with flint material chosen for comparison.

Raw materials, for instance the Cretaceous flints which were brought to Herxheim from great distances, probably arrived at the site in the form of pre-fabricated blanks, an assumption confirmed by the lack of both corresponding cores and characteristic waste material. On the other hand, a small number of pieces made from high quality raw material, such as chalcedony and quartz, were produced on-site, though here this takes the form of an *ad-hoc* production of individual, small blanks.

In Herxheim, the ratio of tools is not only comparatively high, but the frequency of various tool classes, such as scrapers, splintered pieces or sickle blades, differs significantly from those in other regions and at other sites. Whereas scrapers are considerably less frequent than at other sites, the number of sickle blades reused as splintered pieces is abnormally high. The question as to why non-exhausted sickle blades were rendered useless by intentional splintering might be linked to rituals surrounding the burials in the 'ditches'. Splintered pieces are interpreted, among other things, as chisels with which bones could have been split (Fiedler 1979, 117); use of the numerous splintered pieces on the fragmented skeletal remains found at Herxheim could be one possible explanation for their above average occurrence in the assemblage.

A use-wear analysis to be conducted within the frame of the research project will certainly shed light on whether bones from Herxheim were actually split using the splintered pieces found at the site. By and large, the flint artefact spectrum, with its peculiarities and widely dispersed origins, fits quite seamlessly with the exceptional status of this LBK site. The detailed assignment of flint artefacts to given archaeological features and the evaluation of the ground stone assemblage planned within the framework of the research project will show which varieties and forms are associated with the regular settlement, which of them might result from the extraordinary rituals conducted in the 'ditches' during the late phase of the Herxheim site, and which conclusions can be drawn from this evidence.

Worked bone, antler and teeth

The large variety of bone tools and jewellery is as extraordinary as the flint spectrum (Haack 2001; 2002; 2003). In fact, the Herxheim assemblage, which comprises a total of 233 bone tools, antler and tooth artefacts, is one of the largest LBK assemblages ever discovered. Assemblages of comparable sizes are known only from the sites of Cuiry-lès-Chaudardes (départ. Aisne), Vaihingen (Baden-Württemberg), Nieder-Mörlen (Hesse) and Eilsleben (Saxony-Anhalt). At Herxheim, the bone tools clearly dominate with 180 pieces; tools made from antler number 18 pieces, and 35 artefacts are made from teeth (Figure 10). In comparison with the other sites mentioned above, antler objects are considerably underrepresented. However, the large amount of pieces made from worked teeth is even more significant. The number of perforated animal and human teeth is quite exceptional, an observation never before made at a site of this age. At Herxheim, pendants were made from the upper eye teeth of deer, boar tusks and pig canines, cattle incisors, carnivore fangs and human teeth (Figure 10.9–10.13). In some cases, several such pendants were discovered together, which might be indicative of the remains of necklaces deposited in the ditches together with the skull caps and other skeletal remains. Furthermore, the number of tools and unfinished objects made from boar tusk bladelets, which are particularly characteristic of LBK assemblages, is high, comprising a total of 13 pieces (Figure 10.6). On the other hand, there is still no plausible explanation for the relatively low number of antler tools. Despite the low ratio of deer bones in the faunal spectrum at Herxheim in comparison to other LBK sites, this does not tie in with the working of antler itself at the site, where shed antlers were used particularly frequently. However, it is remarkable that waste products and unfinished objects are largely lacking and that the pieces from the site are clearly of a tool character, sometimes with traces of considerable use-wear. Alternatively, they could be grouped with artefacts such as the tooth pendants, i.e. as objects characterised to a lesser extent by their functional capacity but with a more symbolic value, as might be the case with a 21 cm long triangular piece, probably made from elk antler, or the stray find of an antler toggle. The antler tools most frequent at Herxheim are the so called 'retouchers' made from antler tines and used in the preparation of chipped stone tools (Figure 10.5). Apart from a single heavily worn specimen of an antler pick or 'T-axe', such tools are so far unknown in the Herxheim assemblage.

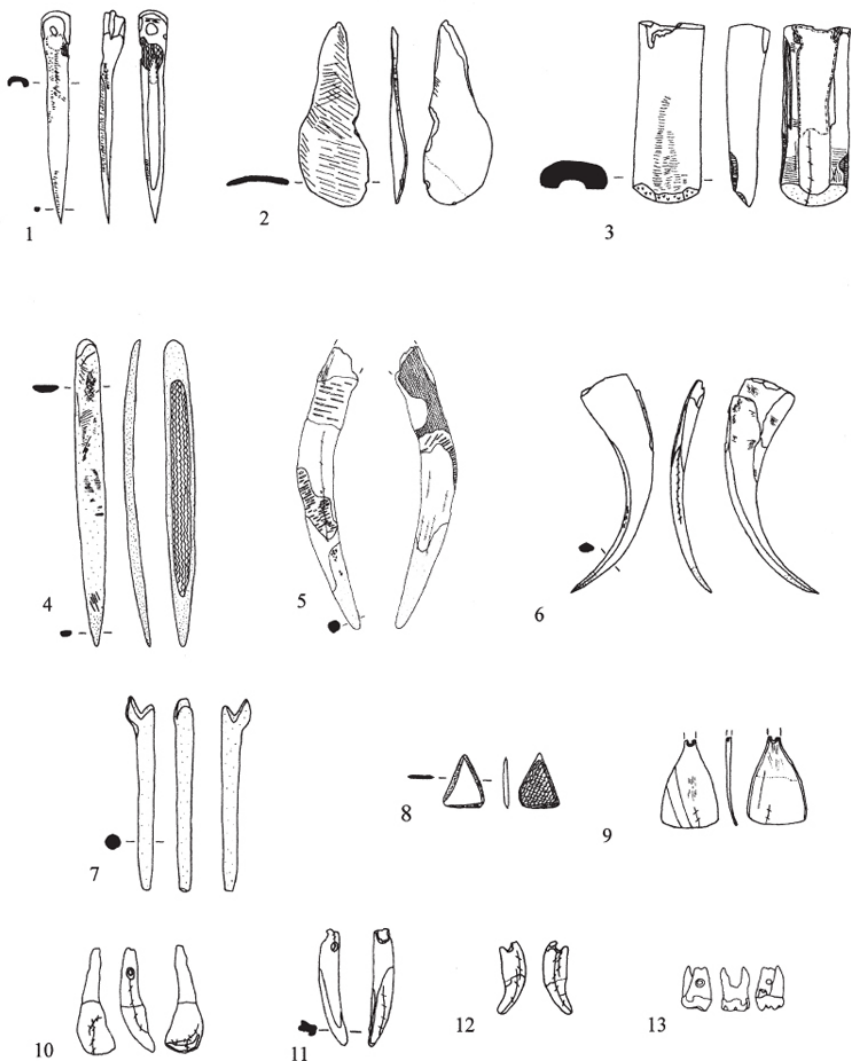


Figure 10. Representative selection of bone, antler, and tooth artefacts.

Among the bone tools, points are clearly the most frequent with 77 pieces. This category of finds is dominated, as is the case in all regions and in all prehistoric periods, by the characteristic 'awls' made of the split metapodials of sheep/goat or deer (Figure 10.1). Furthermore, two points made using the groove and splinter technique, somewhat uncharacteristic objects for the LBK, have been recorded in addition to other, rather unspecific pieces, such as large points made of split deer metapodials used as 'daggers'. In contrast, tools made on split rib bones with a point and a rounded, perpendicular working edge (Figure 10.4) are a fundamental element in the material from early Neolithic settlements in central Europe. These

objects might have been used in pottery production and with 18 pieces comprise the second largest group among the bone tools found at Herxheim. These relatively fragile tools are usually broken, so that only one of the working edges is preserved. In addition, a very large part of the bone tools was probably required for the highly qualified achievements in LBK woodworking. These include two adzes with considerable use-wear traces, several heavily fragmented chisels and a bifacially worked piece which probably served as a wedge. A further artefact group comprises objects which, owing to their 'spoon-like' shape and absence of a working edge, might have functioned as receptacles for substances, i.e. as palettes and spatulas (Figure 10.2). A comparison with pieces from Rosheim 'Saint Odile' (départ. Bas-Rhin) shows that the choice of raw material for this type of implement was not down to a functional necessity. Whilst the objects from Herxheim were made almost exclusively from compact (long) bones and pieces of shoulder blade, mainly parts of rib bones were used in Rosheim.

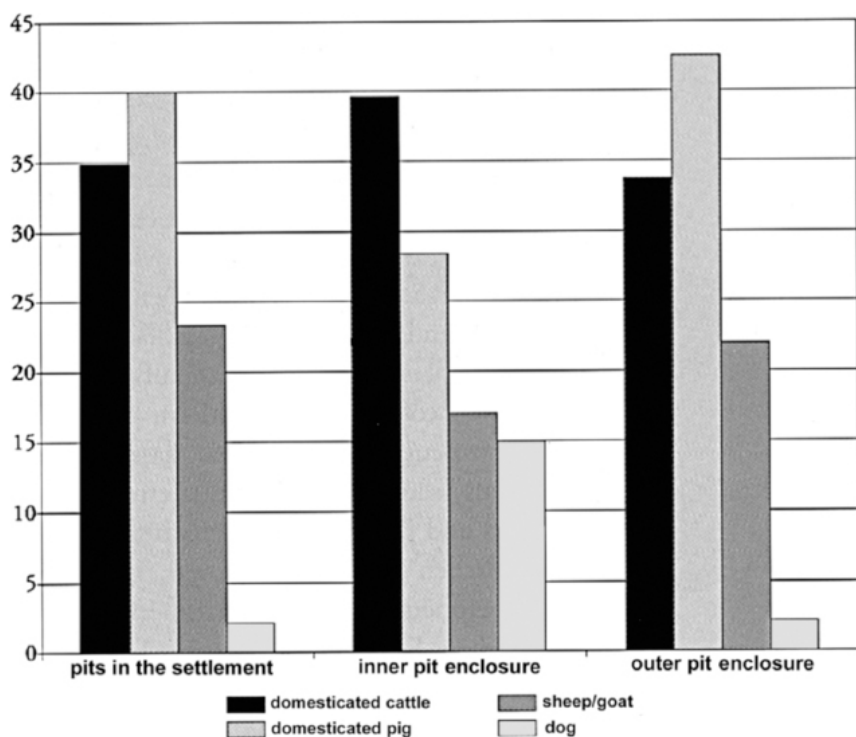


Figure 11. Distribution of animal bones among the pit enclosure rings and the settlement.

Furthermore, there are also bone artefacts which could not possibly have served as tools. These include small bone rods (batons), but also small, faceted, triangular bone points, which are generally interpreted as arrowheads due to their resemblance to pieces made from flint (Figure 10.8). Although both types of objects are known from settlement contexts, just like antler toggles both occur

frequently as grave goods, for example at the cemetery of Schwetzingen (Behrends 1997) or at Sengkofen in Bavaria (Nieszery 1995).

Besides the broad spectrum of tool types, the high percentage of artefacts otherwise practically absent from the assemblages of other LBK settlements is a characteristic feature of the bone, antler and tooth artefacts from Herxheim. On the other hand, these artefacts are objects otherwise well attested with burials, although they are not among the most frequently discovered grave goods. As their interpretation has so far not included a consideration of other categories of finds discovered within the same placed deposits, the groups of finds discussed here have probably not yet made their most significant contribution to the clarification of the character of the human skeletal remains discovered in the earthwork.

Animal bones

Among the animal bones recovered at Herxheim, those of dog are the most abundant. Interestingly, of the more than 200 dog bones discovered at the site, nearly all stem from the inner ring of the enclosure (Figure 11), are generally complete and belong to at least six partially or completely preserved skeletons. As the bones were not smashed and could be assigned to a small number of anatomical units, it can be assumed that in contrast to other domestic animals these individuals were not eaten. It is more likely that the more or less complete animal carcasses were part of the placed deposits in the earthwork. The bones of these animals display diverse traces of burning and cutting, which indicates that prior to deposition at least parts of the cadavers were subjected to fire and had their skull removed. However, this type of treatment has nothing to do with the preparation of food and is more indicative of post-mortem rituals.

Among the other animal bones found in the inner ring of the earthwork, there were also the lower jaws of around 20 carnivores. These are mainly from pine marten and beech marten, but also from wild cat, polecat and fox. In addition to the lower jaws, the bones from the extremities of these animals (metatarsals, phalanges) were also discovered. All of these display fine cut marks, always in the same areas. Additionally, remnants of ochre have been found on a few of the bones. These kinds of traces could be connected with the use of the animals' pelts or might indicate a specific function of these parts of the body, for instance as talismans. Other animal bone finds, such as the horn cores of cattle and small ruminants or parts of the wings of large birds (goose or crane), also underline the special character of the deposits in the enclosure pits at Herxheim.

Pottery

After a year of activities within the frame of the research project, the analysis and evaluation of the pottery in particular have provided not only some important new insights into the chronology and origins of this material, but also into the events which took place at the pit enclosure in Herxheim.

The evaluation of the excavation records has shown that it is only in a certain number of pits of the enclosure, which are dispersed over the entire length of the earthworks excavated so far, that human skull caps and other parts of human skeletons were actually deposited together with the aforementioned categories of

finds, as well as with animal bones and stone artefacts. The pottery from these placed deposits had originally been consistently dated to the latest LBK horizon, which means that until the entire pottery spectrum from both the pit enclosure and its interior was viewed by Jeunesse, the entire settlement had been assigned only to the latest phase of the LBK. However, it is now certain that the earliest houses at the site already appeared in the Flomborn phase of the LBK. Pottery sherds from the Flomborn phase, discovered in some parts of long pits belonging to the enclosure and later refilled, are characterised by their large size and 'fresh', unweathered breaks, which are typical attributes of settlement refuse. The same applies to the material from the subsequent phase of the LBK. This means that the site was occupied continuously from the Flomborn phase throughout the entire LBK sequence.

The complexes described above, comprising skull caps, skeletal remains, pottery, and other artefacts, are without a doubt of ritual character. At present, we assume that Herxheim is a burial site of a quite particular kind. It is as yet difficult to determine whether the settlement within the enclosure was actually occupied up to the end of the latest phase of the Linear Pottery culture (LBK V) or whether the change in its function to a ritual site had led to its abandonment. It is hoped that renewed excavation work at the site (see below) will clarify this. The preliminary occupational chronology of the settlement at Herxheim is summarised as follows:

- Phase 1 (older LBK, phase Flomborn) – single sherds, pottery divided into small fragments (settlement refuse)
- Phase 2 (middle LBK) – single sherds, pottery divided into small fragments (settlement refuse)
- Phase 3 (later LBK) – single sherds, pottery divided into small fragments (settlement refuse)
- Phase 4 (latest LBK) – also single sherds (settlement refuse) but mostly high quality 'ritual pottery'.

The exceptional size of the Herxheim pottery assemblage makes it possible for the first time to define a regional LBK group for the Palatinate. Whereas the local pottery from the middle phase of the LBK can be paralleled with that from the Neckar area (Lindig 2002, especially 73 ff), by the beginning of the later phase of the LBK (jüngere LBKa) a regional variety, typical for the Palatinate, had developed.⁴

The origins of the decorated pottery discovered in the placed deposits dating to the latest LBK phase are astoundingly varied. Whereas the majority of the material from the latest phase is of a local variety belonging to the 'Pfalz group' (Pfälzer Gruppe der jüngsten Bandkeramik), an amazing number of high quality vessels also stems from various regional LBK groups found to the north and east of the Palatinate. Remarkably, however, there is no material from the northwest (Aldenhoven plateau) and just a few sherds from the west (Blicquy group). The hatching style typical of the Rhine-Main region and the Leihgestern style dominate among the regional pottery groups imported into Herxheim during the latest phase of the LBK. A similar number of vessels in the Plaidt style have also been recorded.

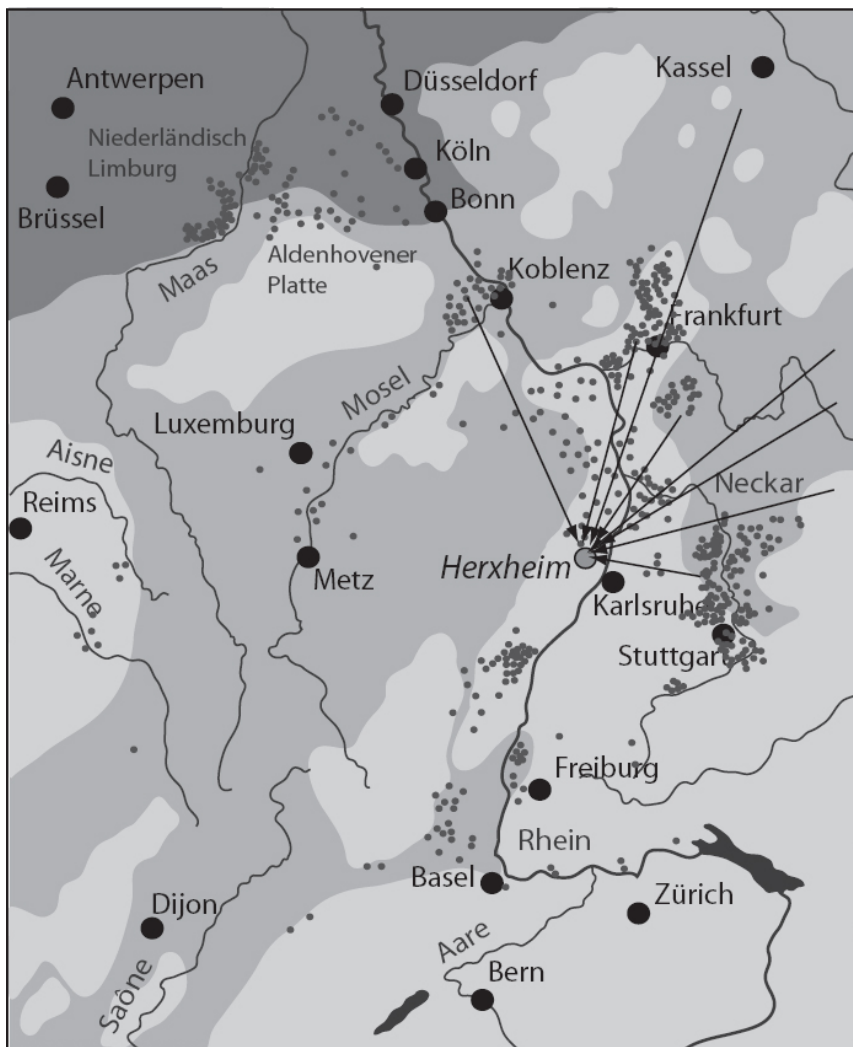


Figure 12. Regional styles of the latest LBK found in the complexes.

Furthermore, some vessels decorated in the Šárka style (LBK of Bohemia and the Elbe valley; see Venc1 1961; Kneipp 1998, 175 ff), as well as a dozen vessels from the regional, but narrowly confined Elster-Saale style (Kaufmann and York 1985) have been identified. These are complemented by pottery imported from the lower Main region, and by a small number of vessels in the style characteristic of the Neckar area (Figure 12). As the analysis of the pottery from the complexes of the two enclosure rings has not yet been concluded, further surprises are certainly still to be expected.

Other important observations could also be made with regard to the pottery from the enclosure pits. The refitting of sherds from different levels within

individual pit fills, which has led to the reconstruction of partial and complete vessels, has not only indicated that rituals took place at Herxheim, but also that individual lugs were intentionally chipped off from mostly small, otherwise undamaged vessels. Whether this behaviour can be interpreted as a ritual aimed at deliberately rendering vessels useless is certainly a subject for future evaluation. The relative completeness of many of the smashed pots, among which bulbous bottles are particularly frequent, demonstrates that the pottery arrived at Herxheim in an undamaged state, only to be smashed in the course of a ritual at the side of the open pits, prior to the vessels' deposition therein. The potential role of fire in these rituals is implied by pottery refits between sherds displaying a black colouration – resulting from a primary firing in a reducing atmosphere – and sherds with an ochre coloured surface (Figure 13), which can only be explained by secondary burning (reoxidation of the iron in the clay). Similarly, some individual skull caps also display a black colouration and partial calcination at their lower edges, which resulted from contact with an open flame.



Figure 13. Refitted pottery sherds of differing colours: whereas the black sherd is representative of the original colour, resulting from a primary firing in a reducing atmosphere, the lighter coloured sherd is indicative of secondary contact with fire.

Generally speaking, three different types of vessel deposits can be distinguished

within the latest LBK placed deposits from the pit enclosure rings:

- 1.Smashed, but completely or nearly entirely reconstructable, decorated and undecorated vessels.
- 2.Small, completely preserved vessels from which only lugs or other types of handle are detached.
- 3.Single sherds of high quality, decorated pottery which display old breaks and for which no refits were found in the pit fill.

First interpretations

All these signs point to different ritual practices and probably to religious backgrounds which remain hidden. At present, the following tentative scenario might be postulated for the events which took place at Herxheim during the latest LBK: delegations from an unspecified region meet at Herxheim, bringing with them either the complete bodies or partially decomposed remains or skeletons, possibly even just the skulls or skull caps, of the dead from their settlement communities. New pits are dug along the course of the enclosure ring, and fires lit on their edges. At these fires, a ritual is conducted as part of the secondary burial of long or even recently deceased relatives. Skeletons are possibly fragmented on the spot, skulls manipulated and long bones smashed. Valuable vessels are rendered useless by breakage, blades and stone tools receive a similar treatment. Grinding stones are also smashed violently. All of these artefacts, as well as the bone implements, tooth and stone jewellery and pottery, are deposited together with the human bones and skulls in the pits. This collection is supplemented by offerings of meat or the single bones of animals previously sacrificed. Subsequently, the pits are refilled.

This portrayal is only one possible variation of an obviously extremely complex ritual. However, following the present state of research we can safely say that this site was neither a latest LBK settlement with a defensive earthwork, nor are the human remains from the 'ditches' evidence for conflict. Rather, the fact that the earliest pits from the enclosure rings have been dated to the Flomborn phase suggests a complex and long-term construction, the background of which still requires clarification. In its latest phase, the double pit enclosure is testimony to a ritual of apparently extra-regional relevance, which according to the pottery evidence involves a whole array of regional groups from the latest LBK. This observation does not fit with the proposition of war and conflict for the latest LBK; rather, the features and finds from Herxheim compel us to re-think the previously accepted explanations, i.e. crisis scenarios, postulated for the regionalisation processes evident at the end of the Linear Pottery culture. Herxheim at least cannot be counted as an example for 'warfare' at the end of the LBK; the scenario at this site rather suggests a special ritual, for which members of different regional groups gathered peaceably and buried their dead in a special way together. In the light of the finds from Herxheim, the question of 'war' in the late LBK surely has to be reconsidered.

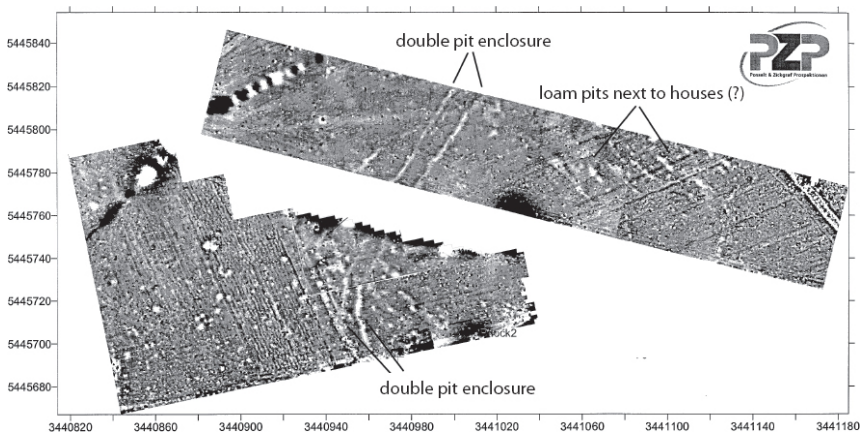


Figure 14. Results from the geophysical survey of the future excavation area and the adjacent land to the north.



Figure 15. Excavation 2006. View of the lower levels of the outer pit enclosure ring. The areas in which the individual pits either overlap or touch are easily discernible.

The new excavations on the Herxheim site

Since June 2005, a further part of the Herxheim site (between the Rohrbacher Straße and the Insheimer Straße, see Figure 1, grey hatched area) has been subject to archaeological investigation (Zeeb-Lanz and Haack 2006). Using a specially

designed excavation method, which is both sensitive to the complex features expected and takes advantage of modern technology (for example, feature documentation using a total station; 3D measurement of all finds from the enclosure pits), attempts are now being made to procure further information and to verify earlier hypotheses developed within the framework of the project financed by the DFG with regard to the previously outlined processes which occurred at Herxheim during the latest LBK. Within the new excavation area, both segments of the inner and outer ring are now being investigated using 10 cm artificial spits. In contrast to the previous excavations, these promise a much clearer picture of the changes in the individual pits constituting the two rings.

A geophysical survey⁵ conducted prior to this work (Figure 14) clearly shows that the double rings are well preserved in this part of the site as well. Furthermore, several visible loam pits raise the hope that the excavation of this area might also yield additional information about the actual settlement at the site. With the new excavation methods, we are able to better understand the construction of the pit enclosure (Figure 15 and 16) and have the opportunity to scrutinize size, enlargement and composition of the extraordinary deposits in the pits of the enclosure (Figure 17) on a highly advanced level. Due to the generous financial support from the municipality of Herxheim and the local company CATEM, a total of three excavation campaigns are planned for this part of the site. This time slot is perfectly adequate for a thorough excavation, and provides ample time to turn attention to issues concerning archaeobotany, geophysics and other related disciplines.

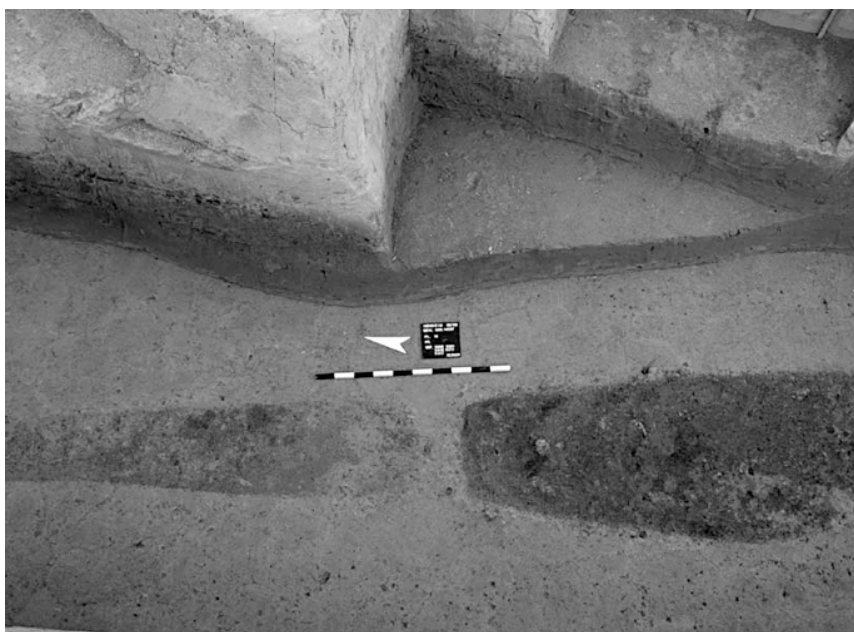


Figure 16. Excavation 2006. Outer pit enclosure ring. Toward the bottom of the features the pits clearly separate from one another.

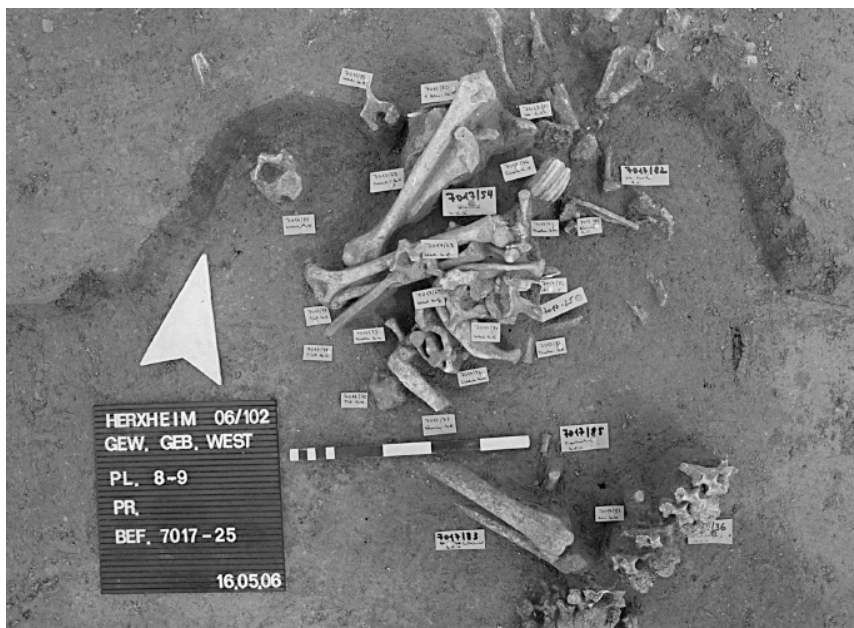


Figure 17. Excavation 2006. A complex with a large number of human bones, some still in articulation, in the inner pit enclosure ring.

The municipality of Herxheim will also profit directly from the results of the scientific evaluation of the 1996–1999 excavation campaigns and from future fieldwork at the site. All new insights are channelled directly into the presentation of the site at the new Neolithic museum located in the municipality itself (“SIS – Steinzeit im Scheunenkeller“), which was inaugurated in April 2005.⁶ Here, many of the finds from the first campaign can be viewed and the inventory will be added to continuously. Thus, we are not only in the position to publish the results of the DFG project, but we also have the opportunity to present the finds of this sensational site, so far without direct parallel in the entire central European Linear Pottery culture, in their very own museum.

Acknowledgements

Thanks are due to the Deutsche Forschungsgemeinschaft (DFG), who has generously supported this project on several occasions. We would like to extend our gratitude to Prof. Dr. A. Zimmermann, Institute for Prehistoric Archaeology, University of Cologne, who kindly agreed to act as secondary applicant to this project.

Notes

This article describes the results of research and interpretation up to the year 2006. Since then, the analysis of the site has already advanced much further.

For additional information, visit www.projekt-herxheim.de

Regions and sites considered: Rhineland [particularly Langweiler 8 (Zimmermann 1988), Langweiler 2 (Langenbrink 1996)], Moselle valley (Schmidgen-Hager 1993), Württemberg (Strien 2000), Kraichgau (Heide 2001), the confluence of Neckar and Rhine (Lindig 2002), Alsace [Rosheim 'Sainte-Odile' (Mauvilly 2000), Wettolsheim-Ricoh (Mauvilly 1997), Ensisheim (Mauvilly 1993a) and Sierentz (Mauvilly 1993b)], Luxembourg (Hauzeur 2006), Kaiserstuhl region (Stöckl 1992), as well as the sites Trier-Euren 'Schloß Monaise' (Schmidgen-Hager 2003), Gerlingen (Strien 1999), Stuttgart-Möhringen 6 (Strien 1999), Ulm-Eggingen (Kind 1989) and the settlements Hilzingen, Scharmenseewadel and Griefßen (Neubauer-Saurer 1993) near Lake Constance.

The exact chronological subdivision of the Linear Pottery culture in the Palatinate, for which Jeunesse has already identified five preliminary phases, will be undertaken by S. van Willigen in the course of the DFG project on the basis of pottery seriation methods.

The geophysical survey was conducted by Martin Posselt M.A. (Firma PZP).

For additional information, visit www.museum-herxheim.de

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Cemetery and settlement burials in the Lower Bavarian LBK

Daniela Hofmann

In spite of a growing body of data, funerary rites remain on the backburner in most discussions of LBK life and society. Partially, of course, this is a numerical problem: settlement sites still vastly outnumber cemeteries, and while settlement burials also occur, the number of individuals remains comparatively low. However, I argue that LBK mortuary archaeology has also reached a point of stagnation. This partly stems from the divisions that have been drawn up between cemetery burial, settlement burial and other 'alternative' rites, divisions largely defined and maintained on the basis of demographic factors and differential provision with grave goods. This has encouraged a hierarchical ordering of burial rites, stressing their perceived differences in status and neglecting other factors, such as their social, mnemonic or emotional impact or their integration into a single conceptual framework. As Sarah Tarlow (1999, 12) has criticised more generally, mortuary data are all too often studied as proxies for social organisation or kinship, treating death "as an empty stage for a variety of other social dramas" and neglecting what can be gleaned from the rites themselves. This is certainly true for the LBK.

This paper aims to blur some of the divisions between kinds of burial in order to re-adjust the focus of enquiry towards attitudes to mortuary rites. LBK funerary practices are now known to be very variable, comprising whole and partial burials, cremations and possible secondary interments and manipulations in cemeteries, settlements and in cave contexts, but here I focus specifically on cemetery and settlement burials. I begin by assessing the reasons for the separation often envisaged between the two rites and argue that as a first step, we must consider more explicitly the importance of factors other than grave goods. There are patterns supporting the existence in the LBK of some general ideas of appropriateness or rules concerning burial rites, and some aspects of these, mainly relating to age and sex, are discussed first. Yet, it would be a mistake to see each interment simply as a passive replication of such norms. Treating burial instead as a dynamic performance opens up wider possibilities of interpretation and helps to elucidate the complex pattern of similarities and differences which exists between LBK interments at different locations. In the second half of the paper, I compare the evidence from two Lower Bavarian sites: the large burial ground at Aiterhofen and the settlement site at Otzing with its unusually high number of burials, and

especially double burials (Figure 1). In this way, I show that the mortuary practices of the early Neolithic allow subtle and overlapping categorisations of persons and identities and their redefinition in the course of varied performances.

Worlds apart – cemetery and settlement burials in the literature

Perhaps due to the paucity of information at the time, Pavúk (1972, 123, my translation) could claim that cemeteries proved the existence of an “exceptionally unified burial ritual [...] in nearly the entire area of [LBK] distribution”, and a similar idea is implicit in some more recent studies (cf. Farruggia 1992, 2; Häusler 1994a, 53; 1994b, 28). Even researchers who recognise variability have so far tended to concentrate on just one aspect in depth, be this cemeteries (Jeunesse 1997; Nieszery 1995), settlement burial (Happ 1991; Orschiedt 1998; Veit 1993; 1996) or fragmented remains (Hoffmann 1971; Orschiedt 1999; Peter-Röcher 1997a). Where a synthesis of different practices has then been attempted (Jeunesse 1997, 43–53; Nieszery 1995, 19–44; Veit 1996, 77–108), they are rarely considered on equal terms.



Figure 1. Map of Bavaria showing the main sites discussed in the text.

In the literature, seven main features of cemetery burial are usually identified as

important for further characterisation: separation from contemporary settlements; a demographic profile often skewed towards male adults; regular patterns in the position and orientation of the inhumations; occasional cremations; few intercutting graves; occasional grave clusters; and, most crucially, differential provision with grave goods (cf. Jeunesse 1997, 53f; Nieszery 1995, 37–43; Veit 1996, 93–108). The correlation of this last aspect with other ritual, demographic and spatial variables generally forms the starting point for social interpretation. Most commonly, value points are assigned to different categories of grave goods and then totalled up for each grave. On this basis, burials are then hierarchically ranked by ‘wealth’ (cf. Jeunesse 1997, 119; Modderman 1985, 105–11; Nieszery 1995, 204–09).

In Jeunesse’s analysis (1997, 111–27) this results in a two-tier model of LBK society: on the one hand, a small wealthier stratum in which socio-economic status is inherited and hence also available to women and children; and the majority of graves, in which the provision of grave goods is biased towards adult men. Notably, non-cemetery burials of various kinds, although mentioned at the start of the volume, are not included in this final reconstruction of LBK social structure. Other issues, too, are comparatively neglected in this and other accounts: chronological change, the symbolic importance of grave goods or the question of whether monolithic categories of identity such as ‘women’, ‘men’ or ‘children’ are appropriate in an LBK context.

Where inhumations on cemeteries have been related to other modes of burial, the absence or reduced importance of grave goods outside cemeteries is used to devalue the other distinguishing features of these contexts. For instance, the lower frequency of goods with settlement burials can become a reason to regard the settlement context in general as appropriate for individuals “unworthy of grave goods” (Lenneis 1981, 28; my translation) or “at the margins of society” (Veit 1996, 205, my translation). Where this can be correlated with demographic variables, like age and sex, these social groups are by extension regarded as undervalued (Lüning 1997, 48; van de Velde 1979b, 44; Veit 1996, 188). This is most marked where bone is fragmented and/or associated with ‘rubbish’ (Veit 1996, 205; Wahl 1994, 88–90; Welge 1998, 95). Farruggia (2002a, 49–65) has gone so far as to treat any variation, from double and settlement burials to manipulation or exhumation of bones, as indicative of a profound crisis and hence something to be valued negatively.

There are thus two main problems. On the one hand, variability within cemeteries is reduced to the single variable of differences in perceived wealth, often to the exclusion of other factors. On the other hand, cemeteries are the basis for a reconstruction of LBK social structure, with other mortuary practices treated as deviations from this norm. Frirdich (2003, 546; my translation) has criticised that, because of its similarity to modern burials, interment in cemeteries “appears as the regular practice, which as such does not require any further explanation”, an attitude she sees as inappropriate. Research then often centres on how this allegedly valued norm relates to various interest groups and their power strategies, such as older men and ‘chiefly’ households. Others, for instance women, children or putative lower-status individuals, are characterised by the absence of one or more of the crucial variables: burial on their own, in a pit dug for the purpose in a cemetery, and with grave goods (see, for instance, Jeunesse 1997; van de Velde

1979a; 1979b). This treacherous familiarity has kept us from problematising other tacitly accepted norms, such as the relationality of the individual and the structuring of identities, the nature of relationships between different groups of people, or the boundedness and impact of the ritual itself.

In contrast, in the German literature, the term most often associated with the practice of LBK settlement burial is *Sonderbestattung*, a 'special burial' in Veit's (1993, 107) translation. In the first instance, this simply refers to a minority burial rite, but as Orschiedt (1998, 35) has criticised, the term is often used with implicitly negative connotations. Where reasons are given, they generally refer to the paucity or inferior quality of grave goods. For instance, Christlein (1981, 21; my translation), describing a vessel found with a settlement burial at Altdorf in Lower Bavaria, comments that individuals on settlements "are quite definitely special burials, which in this aspect [i.e. grave goods] are clearly differentiated from the large 'regular' cemetery Aiterhofen-Ödmühle and its provision with almost ornate funerary ceramics". Others (e.g. Wahl 1994, 88–90; Welge 1998, 94f) have cited the location, careless deposition and non-correspondence to a norm as reasons why settlement burials should be considered as a simple disposal of bodies rather than the result of a burial ceremony in the traditional sense. The problem, of course, is how to identify attributes like 'carelessness', 'lack of piety' or even 'norm' in cosmologies very different to our own (Peter-Röcher 1997a, 59; 1997b, 315f).

Such ideas have not gone uncriticised. Thus, Veit (1996, 178–97) reveals the extraordinary variability in almost every aspect of mortuary ritual on settlements. In this light, "a simple classification [...] on the basis of type and number of grave goods in an assemblage is certainly inadequate if one wants to do justice to the situation in the past" (Veit 1996, 102, my translation). Yet surprisingly, in the last instance Veit (1996, 205, my translation) himself interprets settlement burials as those of people "at the margins of society", associated with refuse and excluded from ancestral status. This is again largely based on the absence of lavish grave goods, which "is most probably related to the generally lower social status of those buried – itself oriented mainly on the variables of age and sex" (Veit 1996, 185; my translation). For the LBK, this translates into a lower status for women and children, who are less well represented on cemeteries but more frequent among settlement burials (Veit 1996, 188). This rather conventional conclusion sits uneasily with other strands in Veit's argument, such as the idea that burial customs are informed by a flexible logic of practice to be applied to each particular circumstance, and hence not reducible to a single variable such as status (Veit 1996, 210–12).

These contradictions stem from a desire for categorisation. The most common approach to LBK burials is to set up general rules and explain deviations from them. Paradoxically, however, this leads to an ambiguous status for settlement burials. On the one hand, their location and rarity make them 'special' – whether in the initially neutral sense of a *Sonderbestattung* or explicitly as discarded and impure dead. Yet on the other hand, it is assumed that the same categories of evaluation used to discuss cemeteries remain applicable: provision with grave goods and regular position and orientation.

There are two main problems with this approach. First, it creates static categories of 'normal' and 'other', in this case cemetery and settlement burial, and

by so doing artificially homogenises a vast variety of treatments and of changes in perception through time. Second, having created oppositions between perceived classes, there is an insistence on interpreting them qualitatively in terms of status, whether defined by wealth and hierarchy or by eligibility to ancestorhood. There is generally very little attempt to define similarities and interconnections alongside differences between modes of burial, although they were practiced concurrently.

Tackling these problems necessitates a framework which allows for the previously neglected aspects of mortuary rites, such as their variation, to be brought back into focus. In addition, we must at least begin to investigate whether static categories such as 'children', 'women' and 'men', and by extension our ideas of the fixed status of individuals in each group, can be relativised. This is not to deny that general patterns exist, but to emphasise that these are the result of a creative process, a selective drawing on accepted customs and not a straightforward replication. Hence, both settlement and cemetery burials are here considered from a dual perspective. On the one hand, a burial ceremony constructs a tableau, an idealised image of the deceased to impress on the mourners' memory. As Wengrow (2006, 115) puts it in his analysis of pre-dynastic Egyptian funerary rites, we encounter "the creation of an image below ground [...] which burial rendered absent or invisible in a deliberate and orchestrated manner". Yet we cannot confine our analysis to the tableau alone, as if it provided an uncritically accepted snapshot view. The image of the deceased does not remain static: first, it is constructed step by step in the course of the ceremony, and may be subject to multiple interpretations throughout. Secondly, the rite extends outwards through time, it is open to new readings in the course of commemorative practices and remembrance or in light of subsequent events. Equally, people bring their own previous experiences and preconceptions to any occasion, and this too shapes its development. Here, the ritual emerges as a performance, it is dynamic, active and unbounded, a "busy intersection" (Rosaldo 1993, 17) of several trajectories rather than a neat, self-contained sphere.

In this way, the excessive hold which grave goods have exercised on previous interpretations can be lessened and alternative factors considered. Each rite can be expected to negotiate its own trajectory between the poles of convention and improvisation. Each is open-ended and involves elements of theatricalisation which depend on the specific and unique constellation of the deceased and the mourners. Calls to this effect are by no means new. For instance, Sangmeister (1999, 665f) points out that expressing emotional connections to the deceased could create a lot of the observed variation and relativises the focus on status. It is precisely these individualistic, small-scale factors that have not received the necessary attention. Similarly, Frirdich (2003, 545) characterises LBK burial as a context for positively valued creative expression, an aspect that explanations hinging on status or chronological change alone cannot deal with adequately (see also Frirdich 2005, 93–97). This is a welcome departure in the way we value variability, although her approach ultimately remains restricted to the cemetery context. Nieszery (1995, 28), in turn, suggests that different kinds of burial show similar concerns, such as the fragmentation of bodies or materials, and that they could hence be metaphorically linked to each other and to other kinds of ritual practices, but he does not take this further (see also Hofmann 2007).

With this background in mind, I first expand on standard approaches to LBK

cemeteries by exploring how identities, beyond economic status, are creatively performed in the interplay between norms and improvisation. This is then extended to settlement burials, using double burials as an example. The differences between these contexts can then be complemented by a consideration of common themes linking them to each other and which are concerned with the expression of grief, the creative theatricalisation of identities and with commemoration. The aim is not to argue for a complete equivalence between settlement and cemetery burials, but to show ways in which the focus on status can be relativised, thus opening up new avenues for exploring the significance of burial in LBK worldviews.

Pattern, performance and commemoration at Aiterhofen

With 159 inhumations and 69 cremations, Aiterhofen, near Straubing in Lower Bavaria, is one of the largest LBK burial grounds excavated so far (Nieszery 1995; Figure 2). The relative dating of the graves remains contentious (see Jeunesse 1997, 55, 94f; Nieszery 1995, 131–38, 188–91; Farruggia 2002b and Hofmann 2006 for discussion), but it is generally agreed on typological grounds that the site begins at some point in the mid LBK (around 5300/5250 BC) and continues through into the middle Neolithic (c. 5000/4900 BC)¹. On the site itself, the graves are arranged into five main clusters, often argued to be family plots (e.g. Nieszery 1995, 66; Pavúk 1972, 126–29; Veit 1996, 44).

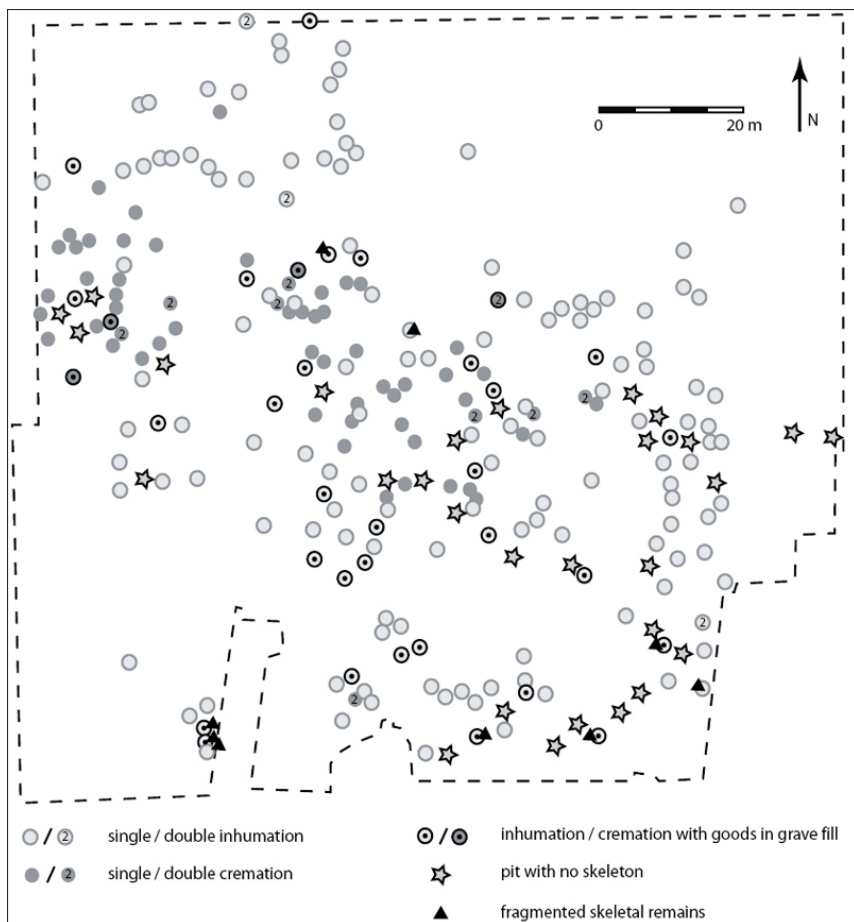


Figure 2. Map of the LBK cemetery at Aiterhofen, after Nieszery 1995, fig. 19.

Thanks to the rich documentation available, Aiterhofen has become a key site in discussions of LBK burial. For instance, Jeunesse's (1997, 111–27) model of social stratification is partially based on the Aiterhofen data, as is Farruggia's (2002b) case for a catastrophic crisis at the end of the LBK. Here, I first outline age and sex-related patterning as a complementary factor to socio-economic status. I then turn to other evidence for ritual activity at the graveside as a basis for discussing the performative elements and the temporalities of burial rites.

Age- and sex-related patterns

It is worth spending some time re-thinking the monolithic categories of 'women' and 'men' which are often at the basis of reflections on LBK social organisation and are seen as one of the main axes along which socio-economic status is attributed. It is frequently pointed out that female graves are more likely to remain unfurnished

and that there are few or no good categories which are exclusive to women, while stone and flint tools and some of the *Spondylus* ornaments are said to be exclusive to men. As a result, women as a whole are characterised as less valued socially than men, with older men being of highest status. Women and children could only acquire status by association with wealthy males (cf. Häusler 1994b, 32; Jeunesse 1997, 95–99; Nieszery 1995, 110–12; Pavúk 1972; Röder 1998, 257; Veit 1996, 104). Adult male graves are hence treated as a kind of yardstick, an ideal grave type against which others can be compared unfavourably. However, this simple picture can be significantly expanded by considering rites and provision with goods for individuals who died at different stages of their life course.

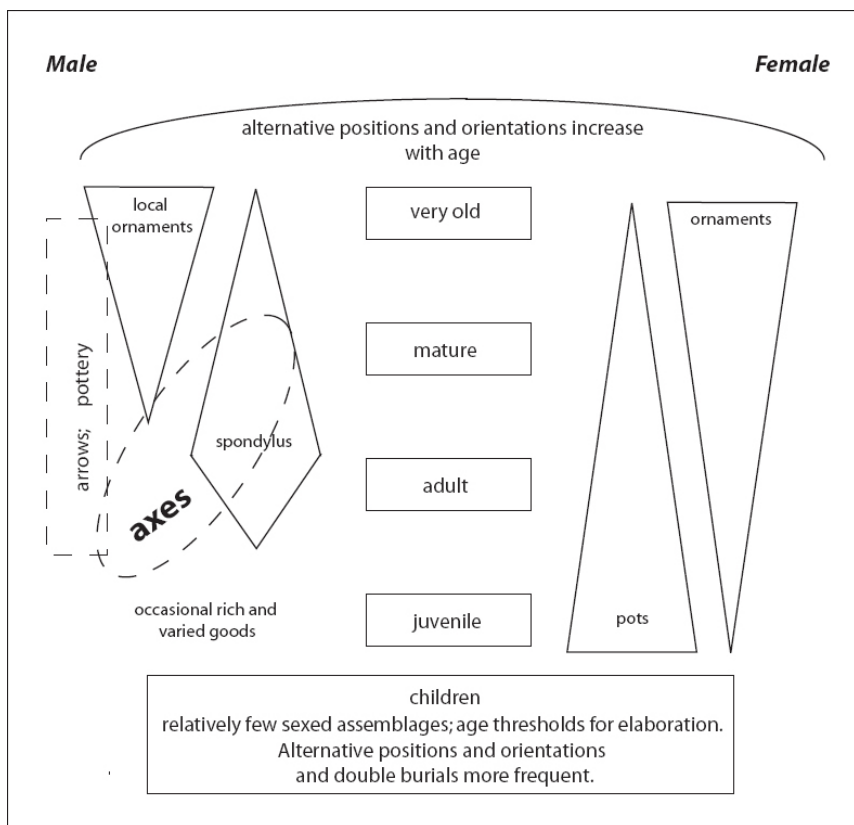


Figure 3. Age and sex-based patterns of common grave good associations at Aiterhofen.

Figure 3 is based on the data from Aiterhofen. It is clear that elements of the burial rite, as well as the likelihood of receiving certain categories of goods, show strong age- and sex-related patterns. Interestingly, however, biological sex is not universally stressed; instead, its importance seems to vary for different age groups. Young children, for example, can rarely be sexed by grave-good association. The repertoire diversifies for older children, but according to Siemoneit's (1997, 32–

35) study into the role of children in the LBK this trend is most marked for individuals between eight and ten and those around the age of fourteen. Marking sex is thus a concern that increases with a child's age and seems particularly important at certain key moments, although it is worth pointing out that the majority of children of any age lack sex markers. Instead, they are more likely to be interred in double burials or with orientations and positions which differ from the norm of left-crouched inhumations with head to the east.

Turning now to the adult males themselves, some age-related variation in grave good provision can be observed. At Aiterhofen at least, only some individuals anthropologically identified as men between 20 and 45 receive what is perceived as the 'classic' standardised assemblage of a set of *Spondylus* ornaments – an arming, beads and a belt buckle – and polished stone tools. Others are entirely unfurnished or receive pottery assemblages – items which render them more immediately comparable to the graves of adult women than to those of other men. Hence, while there are grave good assemblages which differentiate the sexes, there is also a degree of overlap. This is also evident in the admittedly small number of burials anthropologically sexed as women, but buried with 'male' goods such as adzes or arrowheads. Examples occur at both Aiterhofen (Nieszery 1995, 112–15) and elsewhere (Frirdich 2005, 95). The most common reaction by archaeologists is to 'correct' anthropological identifications with an archaeological, i.e. grave-goods based sexing. However, as the number of instances continues to increase, and assuming anthropological sexing to be reliable, we must consider the possibility that in some circumstances, goods cross-over was acceptable (cf. Frirdich 2005, 95; Jeunesse 1997, 97f).

Interestingly, at Aiterhofen it is mostly juveniles and older adults (aged 45 and over) who are affected by this mis-match between anthropology and archaeological expectation. This pattern fits into a picture of an increasing overlap in grave good categories and ritual between older adult men and women. Older women are more likely to receive ornaments of various kinds than their younger counterparts. These can include *Spondylus* items as well as river shells, beads from various materials and bone combs, and these categories are often combined in very idiosyncratic ways. The at least 60-year old woman in grave 32, for instance, was buried with *Spondylus* beads and belt buckle alongside a river shell head-dress and stone beads, while the shells with the woman in grave 60 were combined with a bone comb into an elaborate hairdo (Nieszery 1995, 107; Engelbrecht *et al.* 2003). This variation echoes the treatment of older men (over 60 years old), who can be provisioned with rare ornaments or amulets, such as antler toggles, bone wands and fox mandibles, while their likelihood of having *Spondylus* decreases with age. At Mangolding, a small cemetery ca. 30 km from Aiterhofen, older men were also buried with considerable quantities of river shells, creating a further similarity to the treatment of older women (Nieszery 1995, 310–15). Alternative burial positions and orientations, too, increase with age for both men and women (for further detail, see also Hofmann 2006).

Instead of strict oppositions between 'male' and 'female', then, we are faced with a situation in which differences between the sexes are stressed in the case of some age groups, while being blurred for others. This is most pronounced in the case of children and of adults over 45, with the latter especially showing strongly idiosyncratic trends in grave good combinations and rite, but a certain amount of

overlap can also be argued for some of the younger adults' assemblages.²

We can hence identify broad patterns of age- or sex-related rites and grave goods, but we must be aware of further variation within such broadly defined groups. It is here that the nature of burial ritual as a bundle of various concerns becomes most evident. A person's life or death, and the responses of the mourners to either, lead to a selection of just some of the possible means of ritual expression and their combination. Occasionally, proceedings may be dominated by very specific factors which sit uneasily with preconceived norms and which are difficult to integrate into archaeological schemes based on exclusive and monolithic groupings such as 'rich' or 'poor', 'male' or 'female' graves (see also Whittle 1996, 169).

The adult female in grave 33 at Aiterhofen is a case in point. Her body position is very different from that of the other inhumations, with legs in a rhomboid position and lower arms folded back towards the shoulders. An undoubtedly painful inflammation of the teeth and upper jaw has been identified as the cause of death. Perhaps as a response to this, five of her teeth had been removed and placed on her forehead. Her grave goods were relatively varied for an adult woman, including river shells, a stone bead and red ochre, but they were deposited out of sight in a pottery vessel (Nieszery 1995, 271). Given the anthropological information, the body's position could be interpreted as someone contorted in pain, while the manipulation of the teeth and the de-emphasis of grave goods help to focus attention on the unique and dramatic aspects of this woman's death. Here, breaking with conventions of burial may have been a means of coping with a painful, perhaps shocking or distressing death.

Such individual histories cannot be written for all cases, but the example problematises the way in which emotionally charged events or individually significant relationships could influence the picture of the deceased created in the course of the burial. There are age- and sex-based patterns, but these are not fixed; they are manipulated, adapted and recreated for each performance. In addition, other factors of a person's identity, such as provenance and ethnic affiliation, kin-based identities or economic specialisation of some kind, may all play a role, although it would go beyond the scope of this chapter to address them all in detail (but see Hofmann 2006). However, each of these factors would have an impact on the selection of grave goods and ritual elements and on their interpretation by mourners. It is hence problematic to reduce any aspect of a burial rite to a single explanation. Meanings are not clear-cut and static, but open to multiple and shifting readings.

Such reflections guide us away from seeing burial rituals exclusively in terms of their outcome, as a snapshot picture of a dead body surrounded by goods. By emphasising ritual as a performance or "theatralisation" (Jeunesse 2003, 29), we can focus on its creative elements and dynamic nature. This also involves thinking through the actions of the mourners and the way in which the tableau of the deceased is built up in the course of the rite. Broken objects are one kind of item which can be fruitfully interpreted in this way.

Performance and commemoration

At Aiterhofen, both complete vessels and sherds can be found at the level of the

skeleton, even in undisturbed graves. There is thus no straightforward taphonomic explanation for partial vessels. In addition, there are spatial patterns in the burial of either complete or fragmented pots. But how are such finds to be interpreted? With Chapman (2000, 28–39), we could argue that the missing sherds were taken away by mourners as mementos of the event and tokens of the relationship between the newly deceased and the survivors, thus extending social networks over time and space. Turning to ethnographic examples, one could quote the Melanesian Rauto, who, overcome by grief in the course of mortuary rites, often destroy personal possessions of the deceased by the grave side as tokens of loss (Maschio 1998). The noise and violence implicated in destroying vessels and other objects may also express anger which, following Rosaldo (1986), can be a powerful emotion experienced on the death of a loved one. On Sabarl Island, outbursts of hysterical giving are common among the bereaved, who have to be physically restrained from throwing too many objects into the open grave (Battaglia 1990, 164f).

While it would be unwise to choose any single analogy as a direct parallel for the LBK situation, such reflections throw into focus the poignancy and drama of the occasion, an aspect often neglected in view of the unspectacular archaeological traces it leaves behind. This is perhaps more evident where goods recovered from the grave fill are concerned. Sherds found in levels above the skeleton are occasionally interpreted as the outcome of ritual smashing of pottery (cf. Modderman 1985, 95; Nieszery 1995, 24; Whittle 1988, 155–57), but at other times dismissed as the accidental inclusion of settlement debris (Nieszery 1995, 106; Veit 1996, 96–100). At Aiterhofen, this is perhaps least likely in the case of complete objects, such as vessels or adzes, most often present in the grave fills of older individuals. Equally, where all sherds recovered are part of the same vessel, as in the case of grave 33, accidental deposition of rubbish seems unlikely. Interestingly, at Aiterhofen flint flakes have only been found in the fills of male graves, while Nieszery (1995, 68) reports occasional concentrations of charcoal in the fills of graves.

These activities could be interpreted in the same light as the broken objects at the level of the skeleton: as tokens of emotionally charged performances at the grave side. In contrast, Bonnabel *et al.* (2003, 50) have recently suggested that residue in the grave fills may be the result of a much longer process. In their model, vessels would be left standing as markers beside an open or only partially filled grave and then slowly erode into the gradually subsiding pit. While it is unclear whether this suggestion also applies for Aiterhofen, it identifies commemorative activities as another potential aspect of LBK mortuary rites. Instead of the explosive release of anger or sadness described in the ethnographic analogies above, the slow decay of the object could parallel the ‘forgetting’ of the deceased by the community, or rather, the process of weaving new relationships over the lacuna left by death (see also Bradley 2002, 12f; Küchler 1999; Williams 2001).

The pits without a skeleton which have been identified at Aiterhofen (Figure 2) could be signs of a similar continued involvement with the dead. The features are most frequent in the southern and central areas of the site, and some of them appear to have been completely empty. According to Nieszery (1995, 87f), who gives frustratingly little detail, others contained whole vessels or sherds, as well as

small deposits of charcoal and calcinated (unidentified?) bone. There are several possible interpretations for these features. Farruggia (2002b, 77) suggests the deliberate destruction of graves in the course of inter-community conflict, but it seems strange that potential looters would have meticulously removed even small parts of the skeleton while leaving grave goods in place. Indeed, disarticulated human bone found in the fills of other graves shows that where burials were disturbed, traces remain. More likely, we are here faced with either cenotaphs (Nieszery 1995, 87f) or pits containing the debris of commemorative rites. In this way, rituals connected with the deceased can potentially extend over years and are not confined to a single event (see also e.g. Battaglia 1990; Küchler 1999; Seremetakis 1991). It seems significant that the pits without skeletons cluster in one of the oldest areas of the cemetery, where graves also appear to have been more frequently disturbed. The locations of previous interments, perhaps in areas of the site seen as particularly significant, could have attracted continued ritual attention for some time after the primary burial rite itself, providing the opportunity for further reinterpretations of the event in the course of acts of remembrance.

There are hence indications that the boundaries of the burial rite may not neatly coincide with the limits of the grave in either a spatial or temporal sense. Potentially, this could also result in links between the cemetery and the settlement space. Indeed, it has often been suggested that LBK longhouses may be abandoned before they became structurally unsound and that some examples at least were allowed to decay, slowly turning into overgrown mounds of debris from the collapsing structure. It is often proposed that such episodes of abandonment may be connected to the death of the household head (Lüning 2005; Bradley 2001). Hence, spaces redolent with memories of deceased people may have existed on settlement sites as well as cemeteries, and in analogy to Küchler's (1999) work, it may have taken considerable effort to 'forget' these associations and patch over the lacunae left by death.

In sum, burial rituals emerge as open-ended performances. They create an idealised picture of the deceased for the mourners to remember, but they do so in a complex interplay between established norm and particular situation. There are recurring patterns in the frequency of different kinds of goods buried with specific age or sex groups, and in some cases, such as adult men, this could result in the re-creation of standardised assemblages. In spite of this, few graves are actually identical – precise numbers of artefacts and the occasional inclusion of smaller items, such as fire-lighting kits or ochre, can all vary – and other choices were always possible. It is thus inevitable that some aspects of the deceased's identity would have been foregrounded at the expense of others, providing grounds for varied readings. Different people would leave the graveside with their own interpretations and memories. However, we must also concede that the creation of the tableau itself was a dynamic process which may have rendered the detached contemplation of idealised images of identity impossible. Over the course of the rite, the tableau would change as goods are deposited, smashed and maybe removed, contents spilled or fires lit, as mourners move around and inside the grave, speaking, dancing, wailing, eating.

In addition, the burial ritual is not neatly bounded spatially or temporally. The potential for leaving graves to silt up slowly, the accidental disturbance of older

inhumations or the return to the cemetery for commemorative rites all ensure a prolonged engagement with the dead, as would any tokens or mementos the mourners may have removed from the grave side. Similarly, settlement features associated with the deceased, such as decaying houses, may permanently change the choreography of the everyday as people no longer inhabit or visit the house, but instead move around its ruins between their thickening patches of vegetation, finding ways to cope with the memories of relationships torn by death. It is these qualities of performance, open-endedness and unboundedness which can also be fruitfully brought to bear on settlement burials.

The dead on settlements: double burials at Otzing

The mid-late LBK settlement at Otzing near Deggendorf boasts the highest number of settlement burials so far recovered in Lower Bavaria. In the course of rescue excavations, 29 house plans and 45 burials were uncovered, including five double inhumations. According to Schmotz (2002, 267), two isolated skulls were also present, but he gives no further detail. The site has only been partially excavated and is not yet completely published, but interim reports and a settlement plan are available (Schmotz 2000; 2002; Schmotz and Weber 2000). They show two clusters of buildings either side of a corridor-like free space, possibly the result of erosion (Schmotz 2000, 17), bisecting the site from northeast to southwest. Burials are found in this space, as well as between houses and at the northern edge of the site, where a small group of seven more tightly clustered, but unfortunately badly preserved graves has been interpreted as a separate cemetery (Schmotz and Weber 2000, 22).

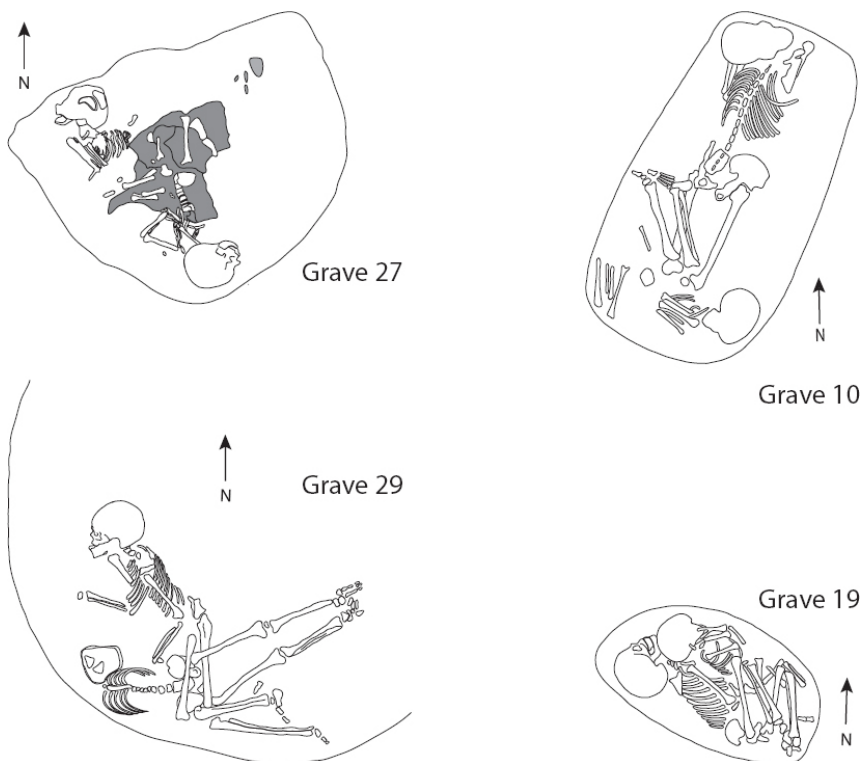


Figure 4. Selected double burials from Otzing. After Schmotz and Weber (2002, 29f).

Generally, the interments at Otzing conform relatively well to the characteristics identified by Veit (1996) and Orschiedt (1998) as typical for settlement burials. Many burials were made in pits originally dug for another purpose and are hence associated with general settlement residues, while in turn they receive few or no grave goods proper. With nine women and eight men (Schmotz and Weber 2000), the imbalance towards female burials generally postulated for settlements is less pronounced than elsewhere (cf. Veit 1996), but in line with expectations children are far more common than adults while receiving fewer grave goods. Although the ‘classic’ left-crouched position for inhumations is still frequent, both positions and orientations of the body are more variable than on cemetery sites.

For the purposes of this paper, I will focus discussion on the double inhumations. While these are generally more frequent on settlement sites than on cemeteries, their proportion at Otzing is particularly high and allows us to draw out interesting performative links and contrasts. This can stand as a counterpoint to Veit’s (1996, 204) claim that double burials are mainly a labour-saving device designed to cope with the high mortality rates especially of children. Instead, I argue that the tableaux created in the course of burial rites on settlements show a subtle interplay between wider norms and local traditions and concerns. This, alongside the performative aspects of the rite and its temporally and spatially open-ended nature allows a more nuanced appreciation of double burials and

identifies parallels to cemetery sites.

Double burials at Otzing show a series of interesting contrasts, for instance between interments with individuals facing away from one another, such as grave 10, and those where they share a common orientation, as in grave 19 (Figure 4). Grave 10 contains a mature person and a small child, probably both female. At first sight, the burial seems rather cramped; the head of the woman had to be bent backwards and her lower legs folded back on to her thighs to make room for the girl, whose legs are even more tightly crouched. This could be interpreted as evidence for double inhumations as labour-saving devices, containing marginalised individuals for whom a large enough pit was not necessary. However, the size of the grave pit is insufficient to explain the arrangement of bodies encountered here, as there would actually be ample room for the girl to the right of the adult. Instead, the child's body is placed to avoid crossing over the knees of the adult. Thus, while the interment establishes a connection between the two bodies by making them share a grave pit, it refrains from direct contact.

Grave 19, by contrast, appears to imply the opposite: here, two children are buried in the same position and facing in the same direction. What is more, the older child is embracing the younger in what could be described as a tender or protective gesture. There seems little doubt that the two children shared an intimate relationship of some sort, although its nature remains elusive. This arrangement is also very similar to that observed for double inhumations on cemeteries, such as the two children in the Aiterhofen grave 131 or in burial 12 at Sengkofen, or the combination of an adult and foetus in Aiterhofen 116 and of adult and child in Sengkofen 10. It is interesting that of the different ways of arranging a double burial evidenced at Otzing, only one should be considered appropriate in a cemetery context.

Grave 27 is different again (Figure 4). Here, the two children have been placed on the sherds of a coarse ware vessel with their heads in opposite directions, but with their legs overlapping. There is again a tension here between closeness and separation, between the intimacy of touch and the distance implied by the antithetical positioning. The closest parallel for this practice comes from two infants between 7 and 14 years of age interred in the same pit complex, but sequentially rather than as part of a double inhumation (graves 31 and 32); their graves are spatially close and their heads, too, are facing north and south respectively.

Grave 29 is perhaps the hardest to characterise (Figure 4). Both individuals, an older child/juvenile and a juvenile, were buried successively in irregular positions. There are signs that the first burial may have been disturbed upon insertion of the second, or was otherwise manipulated, as the arms are missing and the head is displaced. It is unclear how far this could result from the excavation, but this seems unlikely in the case of the absent limbs. The second body is arranged at roughly right angles to the first, expressing a connection between the individuals, but the meaning of this juxtaposition remains unclear. Were the body positions meant to dramatise or enact a specific relationship? The possible removal of bones, perhaps in the course of commemorative rituals, is certainly an interesting dimension. It is paralleled both in the presence of isolated skulls on the site and in the potential re-arrangement or disturbance of one of the bodies in double burial 22 (see Schmotz and Weber 2000, 25).

Although we may not be able to reconstruct the specific story behind each example quoted here, the differences this set of double inhumations displays alert us to the fact that these were not simply careless actions or labour-saving devices, one very much interchangeable with any other. The positioning and orientation of bodies relative to each other can be understood as a subtle measure of and creative resource for expressing relations between the deceased. This could refer to idealised versions of relations or to specific constellations created *ad hoc* for a particular situation. The potential referencing of graves elsewhere on the site, by creating similar tableaux or acting out similar practices such as the rearrangement of bones, could hint at the creation of some local traditions and established ways of expression. In this sense, there is a tension between norm and innovation, but in contrast to cemeteries there is a greater trend towards the latter. This could act as a vehicle for resentment, tenderness, grief and a myriad other emotions. Similarly, settlement burials, like their counterparts on cemeteries, do not simply create a static tableau, frozen in the survivors' minds as the final narrative of the deceased. There is again the smashing of pottery, the arranging of bodies and various items, the actions of mourners and the possibility of different readings. In sum, the Otzing burials, as those at Aiterhofen, are best seen as a sequence of unique theatricalisations, created anew for each individual death but referencing wider patterns of acceptable norms.

A matter of context: differences between settlement and cemetery burial

A similar exercise could easily be expanded to the single interments at the site, but to conclude this article I will briefly return to the differences that are generally identified between cemetery and settlement burials in order to suggest how these can be interpreted beyond socio-economic status. Thus, as has been developed above, both cemetery and settlement burials share aspects of performance and theatricalisation; and to express these they use a common vocabulary of provision with grave goods, orientation and position of the body and other ritual elements such as the smashing of pottery. There are, however, undeniable differences of a quantitative nature: more children and more double burials on settlements, but fewer furnished graves; increased variability in position and orientation, but more later disturbance of burials and more burials in 'rubbish' pits, to name but the most obvious (see also Veit 1996; Orschiedt 1998).

Essentially, the differences can be characterised as a greater tendency towards repetition for cemetery burials and more idiosyncrasies for settlement burials, although this is by no means an absolute contrast. In both locations, there are variability and improvisation, but both locations also show enough similarities to suggest that they are drawing on shared ideas. Perhaps the differential stress on repetition or variation can be partially explained by the spatial context of the rite. The cemetery is a specific place set aside for repeated funerary rites. An individual burial can be consciously placed in relation to other burials stretching back several generations, and indeed the spatial groupings at Aiterhofen suggest such deliberate insertion into an at least partially remembered sequence.³ Being set apart from the space of the living ensures that the place of burial can be honoured and remembered for longer and may remain recognisable even after its occupant is

forgotten as a specific person. This is in addition to more immediate and short-lived memories which may be connected to items of material culture intimately associated to the deceased, such as decaying longhouses. If the cemetery formed a focal point for several settlements (as suggested for instance by Lünig 1997, 48; Nieszery 1995, 21–28), a wider audience for rites may also be postulated.

For settlement burials, there is no spatial separation of the performance of the rite itself and the routine remembrance of the dead. Instead, certain deceased persons are selected to remain close to the living. For any given rite, the number of participants may be reduced compared to the cemetery, and it is likely to comprise mostly people who were in daily contact with the deceased. Under these circumstances, there may have been less of a need to replicate the conventional forms in which the deceased's identity was displayed, with more intimate and emotional aspects being allowed to take centre stage, although the division is not absolute. Furthermore, the longevity of a settlement burial in the minds of the survivors is not ensured by a space specifically dedicated to receive burials over several generations. At Otzing, while there are small clusters of graves, there is nothing comparable to the Aiterhofen groupings. Where grave rites seem to reference each other (see discussion above), this does not involve spatially adjacent interments. Thus, instead of wider spatial references, remembering a settlement burial relied on it being continuously encountered during routine movements and on the associations and memories of survivors – in other words, on living memory. A settlement burial is more intimate and closer, it is constantly present and confronted. But it is also more likely to be forgotten in the long term and to be disturbed or destroyed by ongoing settlement activity⁴.

Conclusions

In sum, characterising LBK settlement burials as a *Sonderbestattung*, whether in positive or negative terms, does not do justice to the complexities of the matter. On the one hand, the term implies some form of common motivation or rationale behind all settlement burials, but the observed variation seems to point to very idiosyncratic narratives behind each performance. Relationships between the deceased and between the dead and the mourners were expressed and re-created each time, drawing on general ideas of appropriateness, but also on the specific circumstances of the interment. Settlement burials should, therefore, not be interpreted in a generalised manner, as a rite appropriate only for those of low status, of a certain age group or unable to become ancestors. Rather, they are emotionally charged performances at which a variety of concerns were acted out, and this is paralleled on cemeteries.

On cemeteries, too, enquiry has been too narrowly focused on differential provision with grave goods and their relation to socio-economic status. The kinds and amounts of goods buried, however, are also intimately connected to ideas of appropriateness relating to age and sex, and it is unclear whether this can simplistically be equated with a person's socio-economic status. In addition, the idiosyncrasies of some burial rites negate the validity of single-factor explanations of the observed variation.

In both contexts, the burial ceremony created a tableau, an idealised image of the deceased, and this at least partially depended on accepted norms and more

widely held ideas of what was appropriate for different groupings within the community, such as age cohorts. However, we must realise the open-ended and ambiguous qualities of the rite as performance, which leave the opportunity for creative adaptations and competing interpretations, and this provides a strong link both between settlement and cemetery burials and between them and other kinds of burial rite.

Thus, while there are differences in demographic composition or the attention accorded to grave goods, there are also powerful factors linking the settlement and cemetery context. It does seem likely that differences existed in the scale of the performance and the level of familiarity between the mourners and the deceased. Yet instead of focusing too narrowly on issues of wealth and economic status, this pattern can also be interpreted in terms of preferred ways of remembrance, of keeping some dead closer and intimately associated with the living, while others were interred in a place set apart. Drawing settlement and cemetery burials together as part of a shared eschatology and world view opens up new avenues of interpretation and refocuses our gaze on the mortuary rite itself. Rather than seeing funerary ritual simply as a proxy for social and economic trends, we must begin to grapple in earnest with the complexities and ambiguities of ritual behaviour and the many factors which influence it.

Acknowledgements

Thanks to Penny Bickle and Alasdair Whittle for their insightful comments on an earlier draft of this paper. Thanks are also due to Stevie Miller and Ian Dennis for help with the illustrations.

Notes

Dating relies on the correlation of typological sequences for pottery with relatively few dendro and radiocarbon dates, the latter often with large standard deviations due to a plateau in the calibration curve (Jeunesse 2001, 19). Bayesian modelling has not yet been carried out. Date ranges given here should hence be regarded as estimates.

In addition, preferences in position, orientation and grave good provision can vary across the different spatial subgroups of Aiterhofen. Thus, *Spondylus* is most frequent in the southern half of the cemetery, but in subgroup 3 occurs more often with women than with men. Subgroup 1 has the highest percentage of individuals buried in a left crouched position with head to the east. There are also differences between sites, such as the relative importance of cremation or the overall amount of grave goods buried (Jeunesse 1997; Nieszery 1995, 28–44). At least some of this variation could be chronological.

However, given the demographic composition and chronological patterns of these subgroups, a straightforward interpretation as family groups seems unlikely.

For potential links between cemetery and settlement burials on the one hand and rites privileging the fragmentation of bodies and grave goods, see Hofmann 2005; 2006.

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Bone temper in early Neolithic vessels from southern Poland. Examinations using Scanning Microscopy

Anna Rauba-Bukowska

Introduction

The oldest Neolithic settlements in Poland belong to the Linear Band Pottery culture (Linearbandkeramik or LBK). This culture came to Poland from the central Danube region in mid 6th millennium BC, as part of the western branch of the Linear Pottery culture (Kulczycka-Leciejewiczowa 1979; Kozłowski 1998). The exact genesis of this culture is not known, but we do know that within a relatively short time, the LBK spread over large areas of the European continent: from the Paris Basin in the west to the basins of the Dniester and the Bug in the east (Kruk and Milisauskas 1999). Across its distribution, the LBK culture represented a quite uniform economic system (Kulczycka-Leciejewiczowa 1979; Kaczanowska 1988; Sommer 2001, 250–51).

The LBK settlers based their existence mainly on the cultivation of plants and on animal husbandry. Due to the agricultural nature of the economy, their favourite settlement places were fertile loess soils. Within Poland, the LBK population lived in the regions of Upper and Lower Silesia, as well as the Małopolska Upland (the Vistula valley to the east of Kraków, the Miechowska Upland and the Sandomierska Upland). Over time, the settlement covered the areas stretching from Rzeszów in the east to the regions of Kujawy, Ziemia Chełmińska and Great Poland (Wielkopolska) in the north. The development of the LBK on the Polish territories lasted until the beginning of the 5th millennium cal BC (Kulczycka-Leciejewiczowa 1979; Kozłowski 1998).

LBK settlements most often consisted of several houses with post-built structures. They were longhouses with rectangular plans, with lengths of 12–40 m. The house interior was probably divided into functional parts, some for human occupation and some for farming purposes (Kulczycka-Leciejewiczowa 1979). The most frequent remains found by archaeologists are the postholes left by longhouses (the upper parts of structures have not remained), longitudinal pits located parallel to the longer sides of houses, as well as further features such as storage pits, hearths or flint workshops, which were located outside the houses (Kulczycka-Leciejewiczowa 1979; Kozłowski 1998). Fired pottery vessels and their fragments

are the most numerous material remains of the activities of those first farmers. The majority of vessel shapes resembled ball-like spheres, that is closed bowls. The vessels were decorated in two ways: by means of incised lines (thin-walled vessels), and by means of nail imprints, little bumps and strips (thick-walled vessels). In the classic phase, the so-called Music-Note Phase, small impressions were added on the incised lines of the vessels (Kulczycka-Leciejewiczowa 1979).

This paper will present new results of specialised research, concerning particularly the organic tempers in the LBK pottery fabric. The mineralogical and petrographic tests of that pottery, which were conducted in the 1960s, proved that the loess clay used for making these vessels contained considerable volumes of organic temper. It was also discovered that the vessels were fired at insufficiently high temperatures within an uneven flame atmosphere, that is, in very primitive kilns. However, the tests did not thoroughly identify the organic materials. Generally, they were believed to be chaff and straw shreds, or other vegetable materials (Wirska-Parachoniak 1969).

The following research is part of a larger project which aims to describe the ceramic fabrics used in the early Neolithic period in the loess areas of southern Poland. Part of the mineralogical analysis of several tens of vessels has already been completed within the framework of that research (Rauba-Bukowska and Pawlikowski 2003). The presence of organic materials was identified in clay fabrics, and it was particularly high in thick-walled vessels. A dozen or so pottery fragments were selected for SEM-EDS scanning electron microscopy tests, in order to be able to identify the organic materials contained in them. This paper presents the results of these tests (Table 1).

Table 1. Sample description

<i>Samples</i>	<i>Kind of pottery</i>	<i>Observed surface</i>	<i>Location</i>
Br1	thick-walled pottery	fresh surface	Brzezie 17
Br4	thick-walled pottery	fresh surface	Brzezie 17
Br5	thin-walled pottery	fresh surface	Brzezie 17
Br6	thick-walled pottery	fresh surface	Brzezie 17
Br12	thick-walled pottery	fresh surface	Brzezie 17
Br25	thick-walled pottery	separated fragments	Brzezie 17
Br26	thin-walled pottery	fresh surface	Brzezie 17
Br27	thin-walled pottery	fresh surface	Brzezie 17
T11r2	thick-walled pottery	fresh surface, separated fragments	Targowisko 11
T11r8	thick-walled pottery	fresh surface, separated fragments	Targowisko 11
T11r10	thick-walled pottery	fresh surface	Targowisko 11
Kr2	thick-walled pottery	fresh surface	Krzesławice 41
BVI	clay	fresh surface	Brzezie (clay)

Materials

Pottery from four archaeological sites was selected for testing purposes: Brzezie (site 17), Targowisko (site 11 and site 16) and Krzesławice (site 41) (Figure 1). Materials from Brzezie and from Targowisko have not yet been published. The post-excavation research was completed recently. Site 41 at Krzesławice was excavated in the 1980s, thus ceramics were selected from the site archive (Kaczanowska 1988).

The sites at Brzezie (17) and at Targowisko (11 and 16) are located on the loess, on the right bank of the Vistula, c. 30 km to the east of Kraków. These are multiphase sites with remains from several Neolithic cultures. Objects discovered there included, among other things, clusters of longhouses and the accompanying flint and pottery assemblage dating back to the early Neolithic (Czekaj-Zastawny *et al.* 2002; 2004; 2006). Fragments of vessels for tests were collected from the lateral pits related to houses, or from isolated pits. In addition, samples of clay were collected in the vicinity of site 17 at Brzezie to make comparative tests. This is a Miocene clay which was exposed after a hilly area had been cut by a small river valley. Site 41 at Krzesławice lies on the flood terrace of the Vistula, on river formations made up of fen soils and silts. The LBK remains on this site were sparse

and had been destroyed by a younger settlement. Most of the LBK artefacts were found in pit no. 90 which contained 213 fragments of LBK vessels and seven fragments of imported pottery related e.g. to the Bükk culture (Kaczanowska 1988, 50–54). Fragments of pottery from that site were used for comparative tests. Only organic fragments contained in pottery fabrics were tested. Mainly fragments of thick-walled pottery were selected for the SEM-EDS scanning electron microscopy testing. Those fragments contained tempers of organic substances, which are visible both to the naked eye and under a polarization microscope.



Figure 1. Location of sites. A-Brzezine 17, B-Targowisko 11, C-Targowisko 16, D-Krzeslawice 41.

Test methodology

The first stage of tests included the analysis of pottery thin sections under a polarization microscope. Thin sections were made of vessels and of clay. The grain-size distribution in samples, their mineralogical and petrographic composition, as well as the component quantity ratios were determined. The results obtained for the Neolithic pottery were compared with those for the clay samples. Particular attention was paid to the occurrence of organic materials in the pottery thin sections.

13 fragments were subjected to SEM-EDS scanning electron microscopy testing (Table 1), with the purpose of identifying organic components. Small pottery fragments (c. 1 cm²) were sprayed with carbon. Fresh fractures of vessel walls were tested. Additionally, organic materials were separated out of several samples. Fragments of sherds were soaked in water, then repeatedly frozen and defrosted. Next, the pottery fragments were crushed and put into water, while the suspension floating on the water surface was filtered. Once dried, small organic fragments were picked out with the use of a binocular magnifying glass and a pair of tweezers. Observations were made at various magnification levels (30–2000x).

Results

The polarization microscope analyses

The mineralogical and petrographic tests were conducted on 55 LBK pottery samples. The tests proved that the mineralogical and petrographic composition of the samples was diverse and made it possible to distinguish several groups of pottery fabric. These groups were slightly different for each site.

The pottery from Brzezie site 17 (Music-Note phase)

This pottery is diverse in both its mineralogy and petrography structures. The thin-walled vessels were usually made of rich clay, sometimes using an unidentified organic material as temper. The thick-walled vessels could be divided into two kinds: those with higher quartz content (c. 30 %) and those which had only up to c. 12% of quartz, but instead a considerable volume of sedimentary rock chips, such as ferruginous shales and chamotte. Both types of vessel contained small fragments of organic materials in their composition.

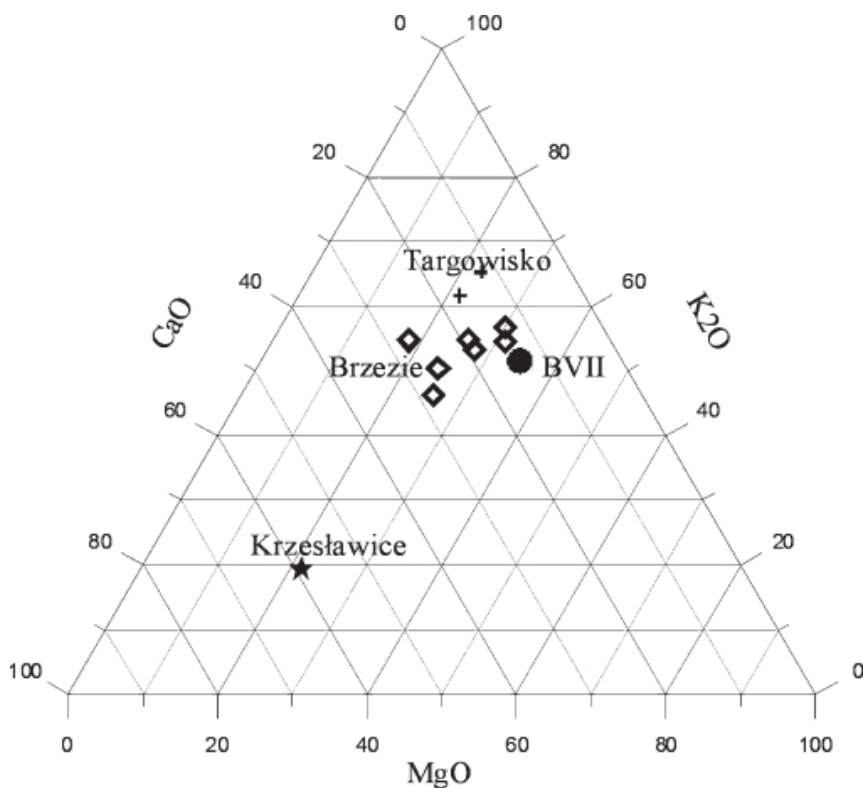


Figure 2. Presence of the oxides MgO, K₂O and CaO in ceramic masses: – pottery from Brzezie 17; – pottery from Targowisko 11; – pottery from Krzesławice 41; – clay sample BVI. Values expressed in percentages.

Another group is that of vessels with a large share of quartz (c. 50%) in their pottery mass. This is a so-called 'sand pottery'. Technologically this kind of LBK pottery is rather poorly identified. Only one fragment was examined. The 'sand pottery' (with a large addition of coarse-grained quartz) is known for example from the Lengyel culture and archaeological sites located near Kraków. It is usually associated with the production of salt from brine sources (Kulczycka-Leciejewiczowa 1969, 57). However, confirmation of such production for the LBK requires further research.

Samples of raw materials collected in the neighbourhood of the site, such as loess, river deposits and soil, as well as three samples of Miocene clay from various depths (10, 20 and 30 cm) were also examined. The analyses showed that the rich Miocene clay was the most probable raw material used. The best plastic properties and the least content of impurities can be found in clay collected at the depth of 30 cm.

The pottery from Targowisko site 11 (Music-Note phase)

Here, the ceramic masses of vessels presented quite a homogenous mineralogical composition. All tested samples displayed similar ratios of silty minerals and quartz. The content of silty minerals oscillated between 62% and 70%, that of quartz between 20% and 30%. In addition, the samples yielded higher contents of muscovite, up to c. 6%. This may prove the existence of another source of raw material, different from that in Brzezcie. The ceramic masses from Targowisko site 11 are diverse as regards their grain-size distribution. The thin-walled vessels were made of medium-grained masses (grains >0.1 mm amount to 10–20%), whereas the thick-walled vessels were made of fine-grained masses (grains >0.1 mm amount up to 10%) and coarse-grained masses (grains >0.1 mm amount to more than 20%).

The pottery from Targowisko site 16 (Żeliezowce phase)

Here, the ceramic masses were characterized first of all by their very fine graining. All examined samples had up to 10% of >0.1 mm grains. The mineralogical and petrographic composition was diverse. The content of quartz ranged from 7% to 52%. It was also characteristic that organic materials could more often be found in thin-walled vessels. The raw material samples (loess clay) collected for comparative tests from the vicinity of the Targowisko sites did not show any similarities to the pottery samples.

Comparison

In order to compare raw materials from the three sites, a comparative analysis of ceramic masses was also carried out. The content of naturally occurring clay inclusion components, obtained by means of the EDS method, was also taken into account. The ratios of oxides, that is magnesium oxide (MgO), potassium oxide (K_2O) and calcium oxide (CaO) in ceramic fabrics revealed variation among samples originating from different sites. The samples from Brzezcie displayed a high conformity between the content of those components and the collected clay sample no. BVI (Figure 2).

Based on the above tests, it was determined that there were remains of organic materials in clay mixtures. They were particularly abundant in thick-walled pottery (c. 10%). Most often, they could be seen by the naked eye (Figure 3A).

Under a polarization microscope, the organic materials with their dark brown, non-transparent colours stood out from the background of silty matrix. Frequently, single fragments had an elongated (Figure 3B, D, E), sometimes arched, shape (Figure 3C, E). In certain cases, the openwork structure of fragments was visible (Figure 3B). It was also noticed that the organic materials were not present in the external, oxidised layers of the pottery. Instead, hollows with identical shapes to those of organic remains were preserved inside the vessel walls. When the vessels were fired, the organic remains were burnt, encouraged by the oxidizing atmosphere. In deeper layers of the vessel walls there was an atmosphere with a limited access of air, which prevented complete burning of the organic materials.

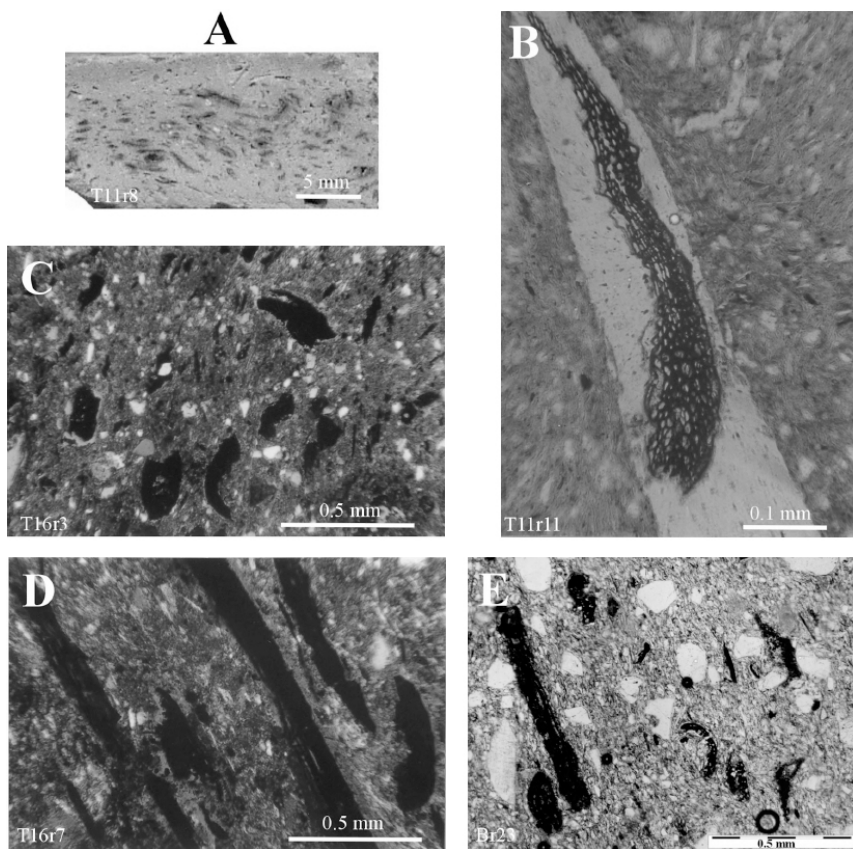


Figure 3. Microphotographs of thin sections. A – minor blackouts and gaps are visible with the naked eye on the fragment cut away from the ceramics. B – openwork structure of tissues. C, D, E – elongated and arched shapes of organic inclusions in ceramic masses visible under polarizing microscope.

Based on the isotropization (thermal transformation) of silty minerals in the pottery thin sections, the temperature in which the vessels were fired was

determined to be 650–750°C.

The scanning microscope analyses

Originally, the tests were aimed at the standard observation of secondary crystallization in vessel walls after pottery had been deposited in the ground. However, the results turned out to be quite interesting and unexpected.

Each sample was examined in the same way. At first, an EDS analysis was conducted in the microarea of c. 2 mm². Next, the fracture surface was observed at different magnifications and all interesting objects were subjected to EDS analysis. The EDS analysis on the fracture surface in the area of c. 2 mm² revealed the increased content of phosphate oxide (P₂O₅) and CaO (Table 2). During further observations, organic remains were detected in all pottery samples tested. The EDS analyses of those fragments revealed an even higher content of P₂O₅ and CaO (Table 3). The detected remains were very small, but nevertheless their structures showed that they were small bone fragments. This interpretation was also confirmed by the presence of calcium phosphate in the remains.

Table 2. Results of chemical analyses (EDS) of 2x2 mm areas of argillaceous masses

<i>No of samples</i>	<i>Symbol of samples</i>	MgO	Al ₂ O	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	Fe ₂ O	Na ₂ O	Zn
1	Br1	0	23.31	41.76	16.13	1	1.58	0.86	16.36	0	0
2	Br4	0.91	18.24	55.57	9.59	2.72	1.34	1.07	10.56	0	0
3	Br5	1.17	16.25	64.33	4.35	2.45	0.85	0.89	9.71	0	0
4	Br6	1.53	20.59	50.77	7.81	2.73	1.65	0.97	13.96	0	0
5	Br12	1.4	15.67	61.31	4.92	2.9	1.45	1.46	10.89	0	0
7	Br26	0.77	17.14	58.46	9.4	2.32	1.29	1.09	9.55	0	0
8	Br27	1.3	17.62	60.79	4.56	2.95	0.91	1.04	10.83	0	0
10	T11r8	0.96	18	60.62	3.18	2.78	0.51	1.38	12.57	0	0
11	T11r10	0.95	19.32	59.45	0.74	2.72	0.74	1.48	14.59	0	0
12	Kr2	1.06	19.47	56.93	8.04	0.96	2.92	1.12	9.5	0	0
13	BVI	2.22	18.03	66.13	0	3.3	0.88	0.84	8.01	0.59	0

Bone fragments were noticed in different sections and the degree of their preservation was different. Bone fragments were small, up to 3 mm, and most often occurred in the form of destroyed, deformed fragments (Figure 4), rarely with preserved bone microstructures (Figure 5). The preserved bones sometimes were found in hollows of regular, elongated shapes. Those hollows had the nature of negatives (imprints), after the total or partial destruction of fragments originally present there (Figure 5G; 6). Often these imprints had characteristic features: on corrugated surfaces, there were uniformly distributed dents with a diameter of c. 10 µm (Figure 7). When their structure and the preservation conditions were studied, three types of fragments could be distinguished.

The first type includes quite flat, corrugated fragments. In cross-section, one can notice duct-like internal structures (Figure 8). The ducts are small, and their size varies between 0.2x0.3 mm and 1.0x0.75 mm. They occur in the form of flat elements, sometimes covered with pipe-like structures. The EDS analyses of those fragments usually reveal an increased content of phosphorus and a little less of calcium (Table 3). Obviously, there are also aluminosilicates in the spectra, but this is an understandable effect in the course of such analyses. The electron beam also collects information not only about the area studied, but also from the surrounding area. This particularly applies to objects within the clay mass. The result is an averaged chemical analysis.

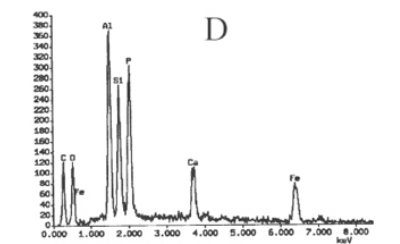
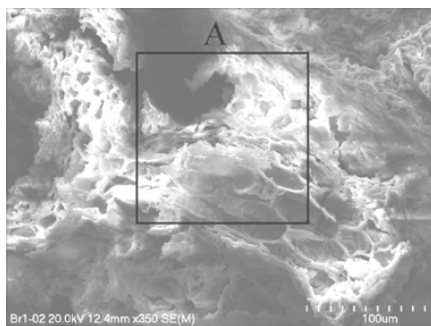
The second type consists of fragments in which the internal bone structures can be seen very distinctly. Usually oval, those fragments have porous and ductlike internal structures. For instance, in sample Br4 an oval fragment of ca. 0.1x0.12 mm diameter is visible stuck in the ceramic mass. Three layers of a porous structure are placed concentrically, forming a void in the centre (Figure 5A). A larger tissue can be seen in sample T11r10, where a fragment of semi-oval, elongated shape was stuck in a larger void. The porous structure of a spongy bone with bone beams (Figure 6A, B, C) is visible inside the tissue. The analysis of these fragments revealed a high level of phosphorus, an increased content of calcium and a considerable content of aluminosilicates (Table 3).

The third type group incorporates highly destroyed fragments of completely illegible internal structures. Only the EDS analyses confirm that these are remains of bone tissues. Sometimes, the only bone mark is the imprinted track, which renders the tissue structure with a high accuracy (Figure 7). The EDS analyses made in such places indicate an increased presence of phosphorus. This is an effect of P_2O_5 migrating from the bone tissue to the environment. This could be proof of bone remaining inside the vessel wall for longer, after the vessel had been fired, and being destroyed later. The same effect was seen within the environment of the existing bone tissues. This proves the process of releasing P_2O_5 from bones (Pawlikowski and Niedźwiedzki 2002, 99). Usually, the content of P_2O_5 is higher than the content of calcium compounds. This can be justified by the gradual (but still quicker than in the case of phosphate compounds) release of calcium compounds from tissues.

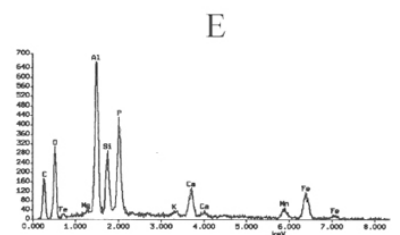
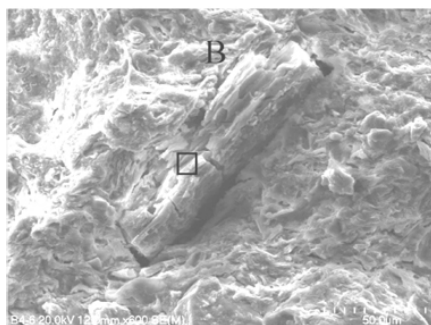
Table 3. Results of chemical analyses (EDS) of organic fragments in ceramic masses

Samples and no of analyses	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	Fe ₂ O ₃	Na ₂ O	MnO	Cl	SO ₃
Br1-2	0	25.97	20.11	29.43	0	8.15	0	16.34	0	0	0	0
Br1-3	0	26.75	33.83	16.10	1.39	2.82	1.74	16.79	0	0.59	0	0
Br1-4	0	28.70	21.98	27.46	1.15	3.83	0	16.88	0	0	0	0
Br1-5	0	33.35	5	39.35	0	4.67	0	17.62	0	0	0	0
Br4-2	0.55	34.70	11.02	28.73	0.97	10.79	0	11.71	0	0	0.36	1.18
Br4-3	0	28.95	17.25	26.57	0.81	7.72	0	18.69	0	0	0	0
Br4-4	0.72	31.43	15.23	26.32	0.70	6.27	0	15.15	0	4.17	0	0
Br6-2	2.01	24.83	52.96	6.33	2.75	1.12	0.76	7.88	0.37	0	0	0
Br6-3	1.91	21.60	53.47	4.96	3.55	1.12	1.27	12.11	0	0	0	0
Br6-4	1.60	26.15	25.57	21.48	1.25	5.07	0	18.87	0	0	0	0
Br6-5	1.49	23.37	38.24	14.52	1.89	2.86	0	17.62	0	0	0	0
Br12-2	1.25	21.11	54.63	4.13	3.15	1.53	0.78	13.41	0	0	0	0
Br25-1 separated	2.62	21.10	19.92	8.71	0	29.02	0	18.63	0	0	0	0
Br25-2 separated	1.89	20.25	30.70	8.68	1.70	16.09	4.37	15.66	0	0	0.66	0
Br25-3 separated	2.46	15.08	2.70	12.36	1.27	37.87	0	26.60	0	0	1.67	0
Br26-2	0	19.53	44.08	18.05	0.92	4.20	0	13.21	0	0	0	0
Br26-3	0	34.35	6.33	31.63	0	6.93	0	14.86	0	5.90	0	0
Br26-4	0	17.70	54.85	18.14	0	1.50	0	7.81	0	0	0	0
Br27-2	1.30	21.51	22.97	20.11	1.62	9.12	0	18.84	0	3.49	0	1.04
T11r2-1	0	20.50	46.90	14.00	1.37	1.71	1.03	14.46	0	0	0	0
T11r2-1 separated	0	30.21	37.31	16.72	1.21	3.50	0	10.31	0	0	0.76	0
T11r2-2 separated	0	5.18	87.15	4.29	0.24	0.88	0	2.25	0	0	0	0
T11r2-3 separated	0.55	24.18	38.67	15.66	1.96	2.79	1.42	14.77	0	0	0	0
T11r2-4 separated	0.44	22.10	52.61	8.96	0.96	3.46	0	11.47	0	0	0	0
T11r2-5 separated	0	20.00	61.65	10.68	0.54	1.39	0	5.75	0	0	0	0
T11r2-6 separated	0	21.26	58.98	10.23	0	2.30	0	7.23	0	0	0	0
T11r10-2	0	50.80	32.32	4.65	0	5.53	0	6.71	0	0	0	0
Kr2-negative of bone	1.03	24.93	49.46	12.56	0.95	2.97	0.91	7.2	0	0	0	0
Kr2-1	1.38	24.05	47.40	13.17	0.93	4.44	1.12	7.51	0	0	0	0
Kr2-2	1.26	21.72	41.39	15.77	1.21	7.64	0.99	10.02	0	0	0	0

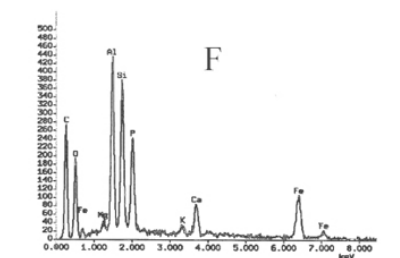
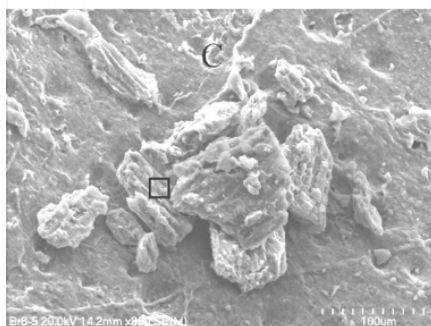
Bones are characterized by their specific structure and composition. This is a composite material, consisting mainly of collagen and calcium phosphate (Martin 1999). Once deposited, chemical and physical processes taking place in the bone impact on the condition it will be preserved in. That condition depends on both internal factors (composition, biological age, species) and external factors (soil pH, ambient temperature), as well as the 'history' of the bone after its deposition (Jans *et al.* 2002). In an acid environment of pH < 6.5, bones are subjected to chemical destruction, that is dissolving. In an alkaline environment, bone remains may be preserved in a very good condition, but sometimes they are exposed to repeated mineralization, which may cause mechanical destruction of their tissues. The growing crystals blast out the bone structures and cause them to fall to pieces (Pawlikowski and Niedźwiedzki 2002, 99).



sample	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	Fe ₂ O ₃
Br1	0	25,97	20,11	29,43	0	8,15	0	16,34

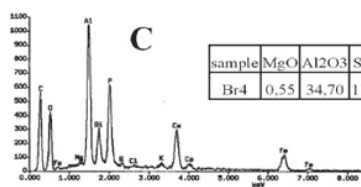
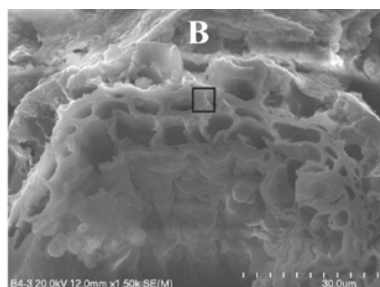
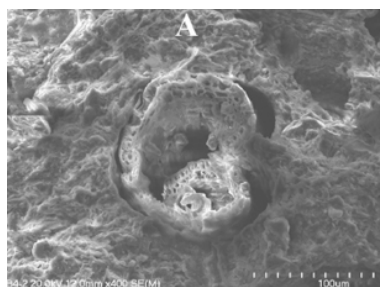


sample	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	Fe ₂ O ₃	MnO	SO ₃
Br4	0,72	31,43	15,23	26,32	0,70	6,27	0	15,15	4,17	0

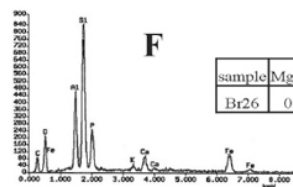
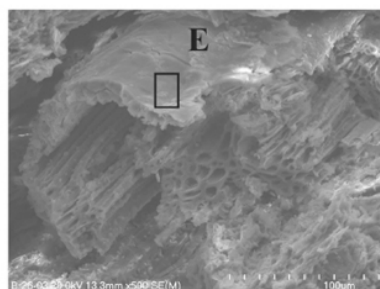
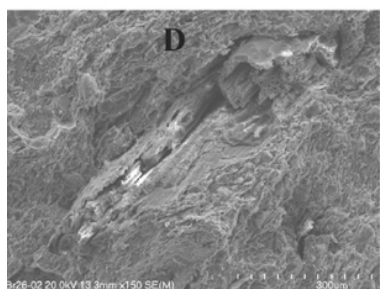


sample	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	Fe ₂ O ₃
Br6	1,60	26,15	25,57	21,48	1,25	5,07	18,87

Figure 4. A, B, C – SEM microphotographs of bone tissue; D, E, F – EDS spectra and results of averaged chemical analysis.



sample	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	Fe ₂ O ₃	Cl	SO ₃
Br4	0.55	34.70	11.02	28.73	0.97	10.79	0	11.71	0.36	1.18



sample	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	Fe ₂ O ₃
Br26	0	19.53	44.08	18.05	0.92	4.20	0	13.21

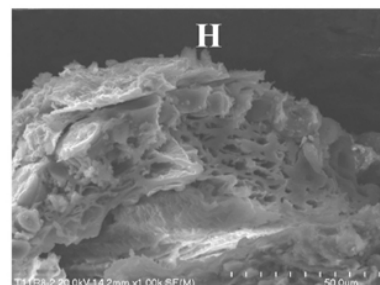
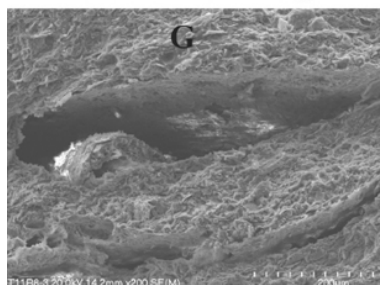


Figure 5. A, B, D, E, G, H – SEM microphotographs of well preserved bone tissue; C, F – EDS spectra and results of averaged chemical analysis.

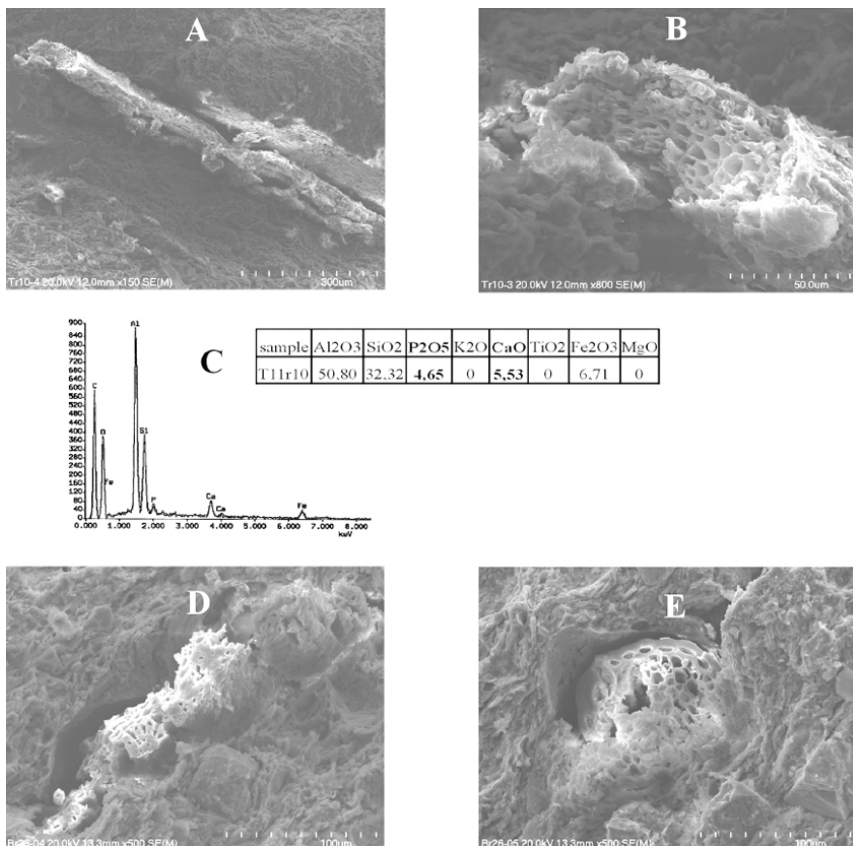


Figure 6. A, B, D, E – SEM microphotographs of well preserved bone tissue; C – EDS spectra and results of averaged chemical analysis.

In regard to bone added to clay, and its destruction, it is also possible to speak of several processes. Firstly, from the moment of its biological death the material is subjected to a slow decomposition. Organic and non-organic components are released and there is a loss of collagen and decalcification. Secondly, bones can be subjected to thermal processing, e.g. through roasting or boiling. During heating, bone goes through several transformations. These processes were described in the works on Grass Tempered Plain Ware (GTPW) from Seacow River, South Africa (10th century) (Bollong *et al.* 1993). Bone heated to 300°C becomes brown, with dark edges. Between 350 and 450°C, bone carbonizes and becomes pitch-black. In the range of 500–650°C, bone loses its dark organic components and begins to change to a light pinkish colour. The process of becoming lighter continues until bones turn a limelike white between 700–800°C (Bollong *et al.* 1993). Moreover, when lying for several thousand years in the ground, both pottery fragments and organic fragments in bones undergo further destruction processes.

It is puzzling that the EDS analyses of ceramic masses show an increased content of phosphorus in the overall silty mass in the amount of c. 1–16% of P₂O₅. The

content of that component was confirmed by chemical analyses carried out using two methods: absorption spectrophotometry and X-ray fluorescent spectrometry (XRF). The average P_2O_5 content is 3% and 2%, respectively. The issue of phosphorus content in archaeological pottery has been described many times (Duma 1972; Freestone *et al.* 1985; Bollong *et al.* 1993; Freestone *et al.* 1994, 425). Most often it is believed to be a result of the deposition of fired vessels in the ground and of their contact with the phosphorus compounds that are released from the soil (Freestone *et al.* 1985; 1994, 425). More rarely it is thought to be a result of the absorption of organic compounds in the course of using the vessel in question (Bollong *et al.* 1993). Samples of clay collected from the vicinity of the Brzezie site were examined in the course of comparative tests. Those tests did not reveal any organic additives and the EDS analysis did not show the presence of phosphate (Table 2). I would like to draw attention to the fact that the presence of bones as deliberately added temper in clays may have an essential influence on the chemical composition of the silty mass.

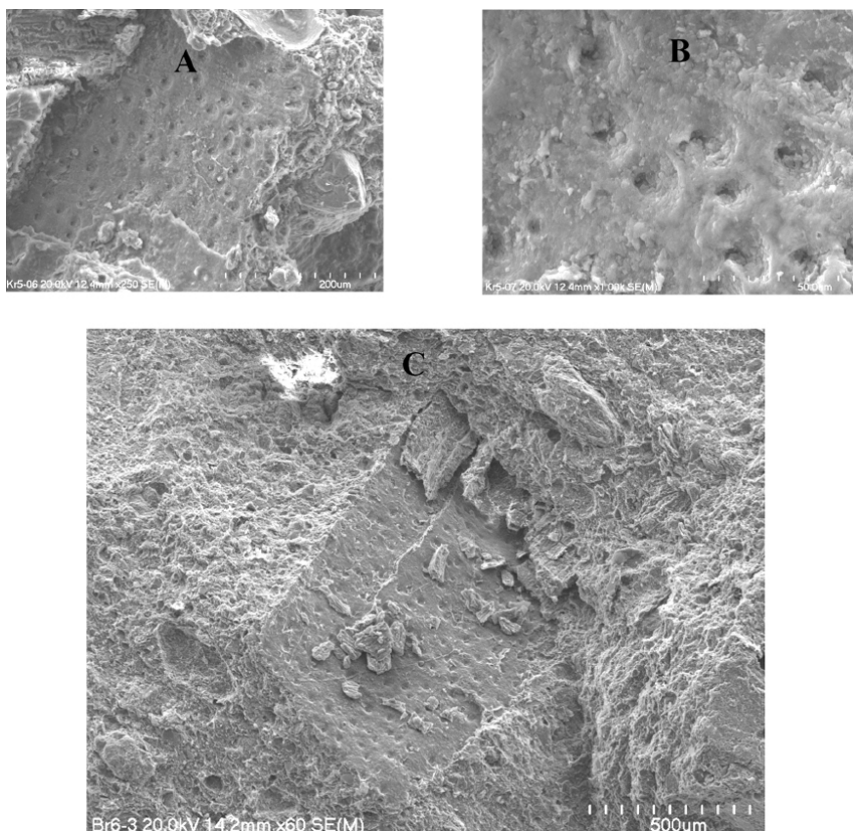


Figure 7. SEM microphotographs of impressions. Very clearly visible uniformly distributed dents.

Conclusions and discussion

Organic temper is characteristic for the whole LBK, although it appears with a varied intensity in ceramic masses from subsequent settlement phases (e.g. in Bylany; Franklin 1998, 3–16). Another constant distinguishing feature is the use of different tempers for different types of vessels. While the thin-walled ceramics were always made from a fine-grained, more homogeneous mass, thick-walled vessels contained coarse tempers resulting in more heterogeneous masses.

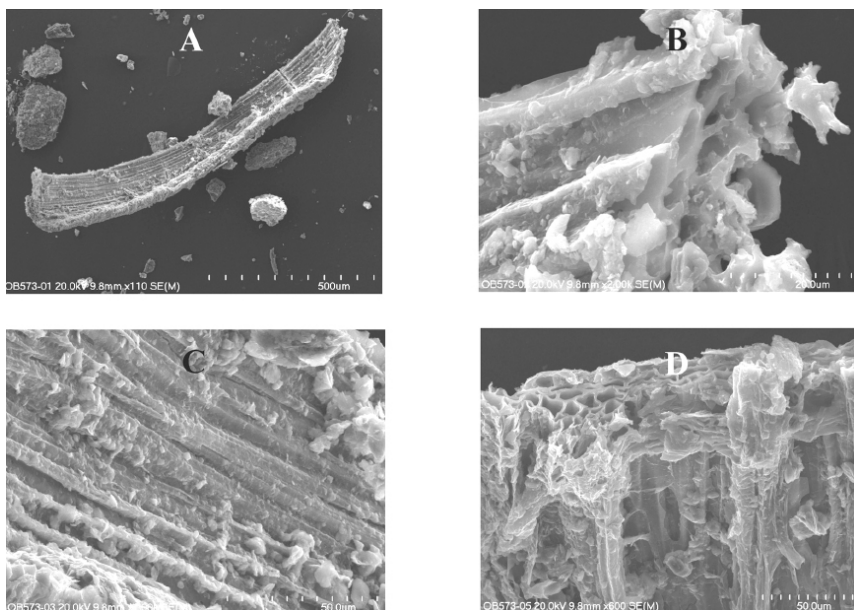


Figure 8. SEM microphotographs of flat, corrugated fragments. Duct-like internal structures are visible in the cross-section.

Based on the tests described here, it was determined that non-plastic materials had been added to clay in various ratios in the course of manufacturing thick-walled pottery. Those tempers included, first of all, organic materials, sand, fragments of sedimentary rocks (ferruginous shales) and chamotte. Accordingly, the thick-walled vessels can be divided into two kinds. The first group includes vessels with higher quartz content in their ceramic masses. The second one includes vessels made of rich clay with a higher content of sedimentary rock fragments (mostly ferruginous shales), dried clay and chamotte; that division is particularly well visible in pottery from the Brzezine excavation site.

Vessels with higher quartz content (c. 30%) have better physical properties. They are less porous, as their ceramic fabric is denser and so they were more suitable for boiling and keeping liquids (kitchen ware). This kind of pottery was fired in a reductive atmosphere. Sometimes, these vessels have features of the thin-walled ceramics, i.e. an ornament incised on the lightly smoothed surface. However, this pottery is technologically different from thin-walled forms, as well

as from thick-walled vessels with a coarse surface (it has a larger quartz content and does not have chamotte and grains of sedimentary rocks as temper).

Vessels made of rich clay with shale and chamotte temper were more porous and could be used as storage ware to keep dry products (e.g. cereal grains). Those vessels could absorb small quantities of water, which was good for the products kept in them. Vessels of this kind have a more oxidised surface and section, which suggests better access of air during the firing process.

Both types of vessel include tempers of very small bones. Their repeated occurrence in the majority of tested samples and an often high concentration of this temper in the silty mass suggests that bones were added to clay on purpose. Bone temper can be found in vessels from each of the three sites under consideration.

The identified bone remains were subjected to various destruction processes. First, the bones were crushed (and maybe also preliminarily baked) before they were added to the clay (Rosenquist 1982). Secondly, in external zones of the vessel walls, the bones were partially burnt in the course of firing. Thirdly, following the use of vessels and several thousand years of their location in the ground, the bones were subjected to destruction. The result of all those processes can now be seen in the form of a poor preservation of bone tissues in ceramics. At present, small and crushed bone fragments are most frequently observed. Often it is possible to see imprints – the ‘negatives’ of those tissues. Furthermore, an increased level of phosphorus in the ceramic masses of vessels may be a result of the bone destruction process. A separate issue is that of the identification of the animal species whose bones were used as pottery temper. However, given the small size and high level of destruction of bones, this may turn out to be impossible.

The practices of weakening (leaning) clay by means of bone temper were noted, among other examples, in the Neolithic pottery from Norway. Originally, the tempers in that pottery were identified as plant materials. However, later chemical tests made it possible to identify them as baked and crushed bones (Rosenquist 1982). Similar practices were found in the early Neolithic Limburg culture in parts of France and the Benelux. Perhaps there is some relationship to the pottery with shell temper from the Mediterranean areas, where shells were widely used as additives (the *cardium impresso* pottery, or Cardial).

It is generally believed that the addition of non-plastic materials (including small bones) to clay minimized the effect of clay shrinkage in the course of firing. It also helped the vessel survive any thermal shock resulting from sudden changes of temperature. Another essential fact is the light weight of bone temper. It did not increase the overall weight of a product, unlike rock chips added to clay. The presence of bones in clay may yield two main results. Firstly, owing to their physical properties (lightness and durability), bones made the vessels lighter, porous and thick-walled after firing. Secondly, the less plastic clay prevented distortions of the vessel once it had been shaped (Walter *et al.* 2004). Those positive features of bone temper could have an essential influence on choosing it.

Here, the question about the level of technological knowledge of the Neolithic communities arises. Were tempers used for cultural reasons (as a cultural characteristic) or only on technological grounds? Taking into consideration the fact that different tempers were applied to various types of vessels, we can assume that technological aspects were a significant factor. However, we should not ignore

the very important matter of tradition. Use of specific ornamentation as well as technology is associated with the continuity of cultural practices and group identity and carries certain values; it characterizes the population.

One can wonder whether those technological 'discoveries' were not forgotten with the passage of time, while tradition still insisted on the continuation of a given custom. The continuation of a method of pottery manufacture without technological justification can be seen in the late phase of the LBK culture (Żeliezowce group; e.g. samples from Targowisko 16). Pottery of the 'Żeliezowce' phase is characterized by a very fine-grained pottery mass. Most probably, loess was added to the clay at the production stage. Such treatment was not observed in the classical LBK phase at the sites of Brzezcie 17 and Tagowisko 11.

Tests on vessels from the Żeliezowce phase showed that during the production of some thin-walled vessels, large amounts of organic materials were added (even up to 23%). The porosity of those vessels amounts to 48% (data from the author's Ph.D. dissertation).

A relationship between vessel form and the type of temper is not visible in the pottery of this phase. It means that the primary purpose of the organic temper – creating lighter thick-wall vessels – was forgotten, but the practice perhaps retained a social significance.

Maybe, adding various materials to clay was related to the conviction that the clay had to be 'domesticated' by adding products originating from household activities. For instance, in certain cases clay was mixed with the remains of flint production, such as small chips, or with those of agricultural activities, e.g. chaff in pottery from Krzesławice (Kaczanowska 1988).

Different tempers can also be related to the character of the settlement whose inhabitants specialized in gathering raw materials, in this case flint. There is an assumption that settlements on the right bank of the Vistula River (e.g. Brzezcie 17) in the study area could be associated with the production of salt. Therefore, these sites would have a different character than settlements on the left bank of the Vistula (e.g. Krzesławice 41). The use of additional tempers would then be a local custom emphasizing the dissimilarity of settlers without changing the technology of pottery production in a fundamental way. For that reason, organic temper – plant material as well as bone – could broadly indicate the agricultural model of living, while the use of local tempers can signify an exceptional character of settlement (flint production). In a later period, the custom of adding organic temper to clay vanishes completely. This can be already observed in the case of the Malice culture, which represents the second postlinear phase of adaptation of Danubian cultural models to the environmental conditions of the area north of the Carpathian Mountains (Kozłowski 1996, 154–64). This is associated with the further development of Neolithic cultures, with economic changes and the disappearance of the LBK in the study area.

Acknowledgements

I wish to thank the Kraków Motorway Construction Agency and the individuals who conducted archaeological excavations, namely Dr. A. Czekaj-Zastawny and Mr. B. Konieczny, for providing materials for tests. I would also like to thank Ms. M. Kaczanowska from the Archaeological Museum (branch in Nowa Huta) for

making pottery fragments from the Krzesławice site available for analysis. I am grateful to Prof. Maciej Pawlikowski for his valuable comments in the course of tests. The analyses were financed by the State Research Committee, Grant No. 10.10.140.44. The tests were performed at the Department of Mineralogy, Petrography and Geochemistry of the AGH University of Science and Technology in Kraków, and at the Field Emission Scanning Microscopy and Microanalysis Laboratory of the Department of Geological Sciences, Jagiellonian University in Kraków, Poland.

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The people who lived in longhouses: what's the big idea?

Alasdair Whittle

What has been done?

For a thousand years or so, across a vast swathe of Europe north of the Alps and the Carpathians, people lived in longhouses. They built these over and over again, perhaps from generation to generation, in smaller and larger settlements or in ribbons down stream and river valleys, but rarely on their own. They worked gardens to grow cereals, herded animals close by and much further afield in the woods and forests, hunted and sometimes fished. They buried their dead in and around their settlements, some in separate burial grounds. Their social networks were extensive, with their settlements clustered from region to region, and they used a very wide range of materials, including stone, flint and shell, brought in from distances, for adzes, axes, tools and ornaments. These are the people of the LBK and its successor groups, from the mid-sixth to the mid-5th millennium cal BC. Their history and character are fundamental not only for the regions of eastern, central and western Europe where they occur, but for many subsequent developments beyond. The LBK is important for more than the LBK alone.

The LBK, with a timespan from 5500–4950 cal BC according to its leading scholar Jens Lüning (2005a, 68–71), has been studied intensively for a century or so. Once upon a time, its study was dominated by the culture idea, by the concept of an incoming, colonising new people, who continued the Neolithic push north and west started in Anatolia and the Balkans, and by intensive research on relatively few sites and microregions. So when I began research in the early 1970s, Köln-Lindenthal was an old story, but enough had already been done in some areas for regional synthesis (e.g. Meier-Arendt 1966; Behrens 1973). The major excavations at Bylany were long established (Soudský 1962; Soudský and Pavlů 1972), and the large-scale work on the Aldenhovener Platte was getting going in earnest (e.g. Farruggia *et al.* 1973; R. Kuper *et al.* 1975; Lüning 1982), with the other major monographs following from the late 1970s (e.g. R. Kuper *et al.* 1977; Boelicke *et al.* 1988). Major work at Elsloo and other sites in the southern Netherlands was just published (Modderman 1970). Excavation was underway in southern Poland at Olszanica, and there was important wider survey of settlements and their placing in the landscape in the same region (Kruk 1973; 1980). There were other studies of settlement preferences (Sielmann 1972). Bohumil Soudský,

meanwhile, had shifted to Paris and the extensive and long-running investigations in the Aisne valley were getting underway (Ilett *et al.* 1982). There were already international gatherings of LBK scholars (e.g. Fitz and Makkay 1972, with papers ranging from Romania to the Netherlands, including a report on the burial ground at Nitra in what is now Slovakia (Pavúk 1972)).

In a review of ‘was bleibt zu tun?’ at the end of his synthesis of the Neolithic in the Mittel-Elbe-Saale-Gebiet in eastern Germany (a title which surely goes back to Chernyshevsky’s famous mid-nineteenth century novel *What is to be done?*, in turn borrowed by Lenin for a major pamphlet in the 1880s (Figes 1997)), Hermann Behrens (1973, 255–56) pointed to past achievements in constructing reliable sequences, in work on individual cultural components, citing Quitta (1960) on the earliest LBK, and in beginning to understand aspects of subsistence, environment and settlement structure. He stressed the future needs to link settlements and burial grounds, to get better information on settlement histories, at varying scales, and on subsistence, and to exploit the physical anthropological evidence of Neolithic people themselves (Behrens 1973, 256). His opening tone in this section was to emphasise the need to remain grounded in archaeological fact (“Es gibt Archäologen, die auf wenig Quellenmaterial einen Wolkenkratzer von Theorien errichten”)¹ (Behrens 1973, 255), but interestingly, one of his previous chapters ranged widely not only over the familiar ground of settlement and subsistence, but also ‘Bewusstsein’ (consciousness), ‘Gefühlsleben’ (emotional life) and religion. The Székesfehérvár conference had also included a paper on LBK religion and cult (Höckmann 1972). I will come back to this dimension later.

So when I look back in 2008 over what has happened since, in many ways progress has been staggering. (Throughout I am only going to refer to selected examples; my list of references could be much longer.) Major projects have largely been published and consolidated. Not only are there now several volumes on Aldenhoven Platte sites including the major site of Langweiler 8 and the burial ground at Niedermerz (e.g. Boelicke *et al.* 1988; Lüning 1997a; Lüning and Stehli 1992; 1994; Dohrn-Ihmig 1983), but others on further sites in the near vicinity, including Weisweiler 111 in the stream valley adjacent to the Merzbach (Rück 2007), and Erkelenz-Kückhoven, with among other things its important wells, on the other side of the Rur valley into which the Merzbach and its neighbouring streams flow (Koschik 2004). The importance of this area as a whole has been consolidated by further detailed studies of lithic procurement and production (and possible concentration in selected sites) (Zimmermann 1995; 2003), and of the transmission of ceramic tradition (Krahn 2003; Krahn-Schigiol 2005), and by refinement of the already very detailed settlement chronologies and histories (Lüning 2005a; Claßen 2005). Olszanica has been published (Milisauskas 1986). Research on the LBK in southern Limburg has been consolidated by continuing regional studies (e.g. Bakels 1982; Louwe Kooijmans 2007), by further excavations at Geleen-Janskampveld (Louwe Kooijmans *et al.* 2003), by archaeobotanical investigations (Bakels 1978), and by intensive research on neighbouring hunter-gatherers in the Rhine-Meuse estuaries (Louwe Kooijmans 2001a; 2001b). There has been a string of publications on Bylany (Pavlíš 1998; 2000; 2002; 2004; 2005; Rulf 1989; Last 1998), and in turn there is much better knowledge of its regional setting and the history of settlement development (Neustupný 1998; Pavlíš 2004; 2005; Zvelebil 2004; Lukes and Zvelebil 2008). The Aisne valley excavations have

been extensively reported (Ilett *et al.* 1982; Ilett and Plateaux 1995; Ilett and Hachem 2001), amongst other aspects the publication of very large and varied animal bone assemblages, particularly from Cuiry-lès-Chaudardes, being particularly significant (Hachem 1997; 2000; 2001).

New sites, and new areas, have come into the frame. Some are the result of planned campaigns, in both research and rescue conditions, like Štúrovo, Slovakia (Pavúk 1994), Darion, Belgium (Cahen *et al.* 1990) or a plethora of settlements in Kujavia, central Poland, again with important animal bone assemblages (Marciniak 2005). This has also produced better knowledge of other specific burial grounds, such as those in southern Bavaria, including Aiterhofen (Nieszery 1995; Farruggia 2002a). Motorway building in northern and western Hungary has revealed longhouse settlements in the north of the Great Hungarian Plain at Füzesabony (Domboróczki 1997; compare Kalicz and Makkay 1977), and south of Lake Balaton at Balatonszárszó (Oross 2004). The appearance of the latter can be linked to important, ongoing research on late Starčevo settlement in Transdanubia (Bánffy 2004; 2008); and then there are the important excavations at Brunn on the edge of Vienna (Stadler 2005). Other sites have thrown up unexpected discoveries, such as the wells already mentioned at Erkelenz-Kückhoven, or the massacre pit at Talheim (Wahl and König 1987; further studies amongst others in Bentley 2007; Eisenhauer 2003), or the massacred dead in the base of the ditches at Asparn-Schletz in Lower Austria (Teschler-Nicola 1996), or the fragmented dead in the ditches of the enclosure at Herxheim in the Rhineland (Zeeb-Lanz and Haack 2006). Violent conflict has been argued for the northwest frontier, on the basis of the evidence from Darion and other enclosures in Belgium (Keeley 1998).

Specific themes have also been taken much further by specialists. I have already mentioned ceramic transmission, and lithic procurement and production in northwest Germany (Krahn 2003; Zimmermann 1995; 2003). There have also been important studies of lithics from the earliest phases of the LBK (Gronenborn 1997; Mateiciucová 2004; in press), which are transforming our understanding of what was already on the move and being made in the late Mesolithic and how this may have contributed to earliest LBK techniques. Houses themselves have been much further studied (Hampel 1989; Coudart 1998), with the stress on regional variability, and the same can be said of both burial grounds (Jeunesse 1997) and settlement burials (Veit 1996; Orschiedt 1998). Related specialised studies have even focused on the role of children (Simoneit 1997; a major theme too in the argument of Jeunesse 1997). Animal bone is not evenly preserved across the loess soils of central and western Europe, so the studies already noted from the Paris Basin and central Poland far outrun those available to Behrens, for example, in the early 1970s (for example, Müller 1964), both in numbers and diversity of species represented. Both Rose-Marie Arbogast (2001) and Lamys Hachem (2001) have stressed the variability of the presence of hunted animals, the latter noting (Hachem 2001, 97–98) their significance for the identity of *Rubané* households and communities. Then there is the important model of garden cultivation, involving limited but intensive cultivation, winter as well as spring sowing, and long durations for favoured plots (Bogaard 2004; Bogaard and Jones 2007; Bogaard *et al.* 2008), which offers a different perspective to older ideas of shifting cultivation (at least as far back as Soudský 1962) and to the alternative of more extensive fields (e.g. Lüning 2000; reviewed also in Kreuz 2007). And then there

have been the pioneering isotopic studies of human and animal remains, fulfilling the promise noted by Behrens, by indicating a range of movement at lifetime scales not previously much considered in the dominant model of sedentary longhouse existence (Price *et al.* 2001; 2003; Bentley 2007; Bentley *et al.* 2002; 2008; note reservations in Bickle and Hofmann 2007). Finally, aDNA studies of human remains are beginning to complement, perhaps in the future to replace, inferences from investigations of mitochondrial and Y-chromosome patterns in modern populations (e.g. Haak *et al.* 2005; Alt 2005; Richards 2003). Similar studies on animal remains, though not aimed specifically or exclusively at the LBK, are also relevant, suggesting for cattle and pigs an influx of non-native species, but perhaps allowing some degree of mixture with indigenous species (e.g. cattle: Bollongino and Burger 2007; Bollongino *et al.* 2006; Edwards *et al.* 2007; Götherström *et al.* 2005; and pigs: Larson *et al.* 2007).

Then there has been the matter of the Mesolithic-Neolithic transition. Three developments have been particularly important. From the later 1980s onwards, some scholars began to reflect on the possible or likely contribution of indigenous people to the formation and development of the LBK (e.g. Modderman 1988; Kind 1998; Tillmann 1993; cf. Whittle 1996). Then there was the major project on the earliest LBK, involving a series of excavations on sites in Germany and Austria, including Bruchenbrücken (Lüning 1997c), Schwanfeld (Lüning 2005a), Neckenmarkt and Strögen (Lenneis and Lüning 2001), with related studies on pottery (Cladders 2001), lithics (Gronenborn 1997), houses and dates (Cladders and Stäuble 2003; Stäuble 2005), settlement and cultivation (Kreuz 1990) and animal bone assemblages (Pucher 1987; Uerpmann and Uerpmann 1997). But the scope of such studies has not been confined to the German-Austrian project alone, as witnessed by the range of papers in a recent review (Lukes and Zvelebil 2004). Thirdly, research has also gradually intensified around the theme of La Hoguette and Limburg ceramics and the still rather shadowy identity of who made and used these apparently non-LBK wares (e.g. Lüning *et al.* 1989; Lüning 2005a; Gronenborn 2007). There have been unexpected discoveries which indicate the potential complexity of interactions in this horizon, such as that recently of a clay seal in a late Mesolithic context, probably in the late 7th millennium cal BC, at Arconciel/La Souche, canton Freiburg, in western Switzerland, which strongly resembles Balkan exemplars (Mauvilly *et al.* 2008). This gives potential further credence to those pollen studies, north of the Alps and even as far north as the Wetterau (Erny-Rodmann *et al.* 1997; Schweizer 2001), which have suggested pre-LBK cereal cultivation in some kind of indigenous context. So over the last twenty years especially there has been a significant change in attitudes to the question of the Mesolithic-Neolithic transition, with now a considerable range of models involving both incomers and local people, in varying combinations depending on place, circumstance and point in the sequence (e.g. Gronenborn 1999; 2004; 2007; Zvelebil 2004; Mateiciucová 2004; 2007; in press; Whittle 2003, chapter 7; Fridrich 2005, fig. 3). Detlef Gronenborn (2007, 84) has referred to 'multi-tradition communities' *within* LBK settlements, which would previously, before this debate and before the results of isotopic analysis, have been seen as single or undifferentiated entities.

Out of all this have come much stronger narratives of the overall development of the LBK, again serving to break down any monolithic characterisation (e.g.

Gronenborn 1999; 2004; 2007; Fridrich 2003; 2005; Cladders and Stäuble 2003; Stäuble 2005; Zvelebil 2004). In very brief outline, beginning probably in the mid-6th millennium cal BC, there were varied interactions, integrations and fusions, which produced the transformations which we recognise as the earliest LBK. This may have taken place principally in some kind of core area between the eastern end of the Alps and the Danube, but whether this is really a matter of Transdanubia alone is a matter for further research; on the one hand there is more to say about the late Körös culture on the Great Hungarian Plain, and on the other there seems to be interaction within existing networks, for example for the transmission of Szentgál radiolarite, which go far westwards beyond Transdanubia (Mateiciucová 2004; 2007; in press). While the typologically earliest LBK pottery may in fact overlap with the succeeding Flomborn phase in the west (Lüning 2005a), there was a phase of relatively small and perhaps regionally dispersed longhouse settlements, some at least arranged in rows, as at Schwanfeld (Lüning 2005a). These people were cereal cultivators and animal keepers, but subsistence patterns may have been quite varied (Pucher 1987; Uerpmann and Uerpmann 1997; Kreuz 1990; 2007), and to my knowledge there has been little isotopic and dietary analysis in general so far of this phase.

In the succeeding Flomborn phase, at least in the areas further west, there was marked change. Houses change in size and internal layout, with much regional variation in the detail; bigger settlements appear over time, some probably of much longer duration than in the *älteste* phase; in some cases, such sites appear to have been first founded in the earliest phase (Petrasch 2003), but this may well have been different elsewhere. Settlement appears for the first time west of the Rhine, as far as the Maas and into eastern Belgium. Supplanting the earlier principle of house replacement within rows, the practice of wards centred on freestanding longhouses with their own surrounding space may have come to characterise many settlements, such as the large, founder site of Langweiler 8 on the Aldenhovener Platte; later phases may have had only one active longhouse, while other sites spread along the Merzbach and other stream valleys in the region (Lüning 2005a, 64–67; cf. Fridrich 2005). But the Aldenhovener Platte model does not need to describe or encompass what happened everywhere else. This is the time when both isotopic analyses of provenance and the garden cultivation model best apply (e.g. Price *et al.* 2001; Bentley *et al.* 2002; Bogaard 2004), and a complex picture is perhaps emerging of communities both rooted in place and very local activity, and bound into much wider networks within which both people and their animals were regularly on the move. Much of the evidence for burial grounds and for movements of materials including stone axes and adzes and *Spondylus* shells belongs here.

More generations pass, and ceramic styles become more regionalised. It has been claimed that settlement density by the end of the sixth millennium cal BC could be regionally dense (e.g. Zimmermann and Wendt 2003; compare also enthusiastic estimates for earlier situations in Petrasch 2001). Settlement becomes more established in the Paris Basin. In the view of some researchers, the newer evidence for inter-personal and inter-group violence, from sites such as Talheim and Asparn, can be linked to that for settlement densities and even perhaps for resource over-exploitation in the woodlands, to produce a model of resource stress, inter-community conflict, and general crisis at the end of the LBK, perhaps exacerbated

if not caused by adverse climatic conditions (e.g. Windl 1996; Petrasch 1999; Farruggia 2002b; Gronenborn 1999; 2007; Spatz 1998; Strien and Gronenborn 2005; Wild *et al.* 2004). That interpretation of wider events remains disputed; controversy has shifted from the beginning to the end of the LBK. Talheim and Asparn are widely separated in space, and may not date to the same generations; there are many regions where such evidence is so far lacking. The character of Herxheim (Zeeb-Lanz and Haack 2006) opens up many other possibilities, of regional interaction as much as regional competition, of a play between individuals and community, of the merging of more individual identities into wider representations, and of a kind of violence meted out to the remains of the dead. None of this speaks against further dynamic change, but perhaps tells in favour of developments more complicated than 'straightforward' resource stress and inter-community conflict.

A longer summary would do far greater justice to regional variation, not only in the end phase of the LBK, but also in its main phase of established settlement, and further exploit that sense of a widening data base noted above. Rhineland studies have essentially emphasised settlement continuity, for example, generation on generation, whereas the detailed publication of Bylany envisages several breaks in the site sequence (Pavlů 2000; 2002); but neither the Rhineland nor Bohemia has yet thrown up an example of settlement history like that of Vaihingen in Baden-Württemberg, with longhouses closely set within a primary enclosure, which is later used for gradually accumulating burials (Krause *et al.* 1998). It is worth noting, finally, the two dominant tropes within which this accumulating evidence has been debated over the last twenty years or so. The notion of diversity in uniformity, mooted by Modderman (1988), has been widely followed, glossed for example as variations on a theme by Gronenborn (1999). This has rarely been challenged, though Ivan Pavlů (2005, 41–42) has questioned whether any idea of uniformity in the first place is not just a construct of modern researchers far distant from the LBK. Eva Lenneis too (2005) has suggested that continuing research into the earliest LBK produces more and more variation. And John Robb and Preston Miracle (2007, 113) have argued strongly that adoption of material practices has to be seen in terms of social strategies, in the case of the earliest LBK, of the consolidation of difference: from the past and from neighbours.

Secondly, it is overwhelmingly clear that another recurrent, dominant approach has been that of the socio-economics of individual settlements. The tone was already set by one strand of what we found in Behrens' synthesis in 1973: a wish to remain empirically grounded, and to set principal questions of settlement and subsistence history, with some limited social reconstruction. It is striking when one looks back on other summaries since how much that kind of dominant agenda has been followed – and this is not intended in the first place as criticism, but rather observation. Modderman (1988) set out a strongly descriptive framework, focused on environment, settlement, houses, food production, the dead as indicators of social structure and inter-regional connections. Lüning (1988; 1997b) followed a quite similar remit, further developing the idea of complex, early interactions among different populations, and concentrating on the ward or *Hofplatz* model, for the Aldenhovener Platte and Hessen respectively, but within a framework of regional settlement hierarchy. He has further summarised extensive evidence for economy and environment (2000), and will return to settlement organisation in a

forthcoming publication (Lüning forthcoming). And these same sorts of themes are seen in the most recent collections of LBK papers and elsewhere (e.g. Eckert *et al.* 2003; Lüning *et al.* 2005; Zimmermann 2001).

Within this kind of perspective, much of the debate has centred on the question of relations within and between communities. On the one hand, there are those who see LBK communities as in the end more or less egalitarian, or with very weakly developed differentiation (e.g. Milisauskas 1986, 215–18; Modderman 1988; Coudart 1998; Whittle 1996). Sarunas Milisauskas, for example, has offered a nuanced view of difference between regions, contrasting the apparent dominance of older men in the Nitra burial ground with more balanced provision of grave goods between men and women at Sondershausen in eastern Germany (Milisauskas 1986, 215). He saw house construction as a shared task, with ovens held in common between longhouses; but some of these may have had ‘persons of local influence’, seen in uneven deposition of obsidian and axes around the longhouses, and some sites, like Olszanica, exported or directed Jurassic flint from nearby sources to other places further afield (Milisauskas 1986, 215–17). On the other hand, there are those who have seen much greater differentiation within and between LBK communities (e.g. van de Velde 1979a; 1979b; 1990; Jeunesse 1997; Fridrich 2003; 2005; Gronenborn 1999; 2004; 2006; 2007; Petrasch 2003; Strien and Gronenborn 2005). This view has been partly based on settlement layout (e.g. van de Velde 1979a; 1979b; 1990) and partly on the burial evidence, especially that of burial grounds (e.g. Jeunesse 1997). Christian Jeunesse, for example, has stressed the uneven provision of grave goods, including in some areas the generous quantities deposited with children and juveniles, suggesting some principle of inherited or prescribed social status. Others have fitted the more varied and in many ways puzzling evidence of settlement burials into this kind of framework, with the rarity or absence of grave goods taken, following the same principle of equating status quite straightforwardly with goods scores, as an indication of lower status (e.g. Modderman 1988, 122). It is worth noting here another perceptive remark by Behrens (1973, 242), that the absence of grave goods in such settlement burials may speak for a continuing, strong sense of connection with the realm of the living. In other words, though Behrens did not elaborate the consequences, wider conceptions of context, community and death itself have to be taken into account. Notwithstanding, this differentiating school of thought has even included the possibility of statuses or personae such as slaves and witches (Gronenborn 2004; 2006). This model might bear comparison with the world of the nineteenth-century Russian peasant *mir* or community, in which:

...beneath the cloak of communal solidarity observed by outsiders, fellow villagers continued to struggle between themselves for individual advantage. The village was a hotbed of intrigue, vendettas, greed, dishonesty, meanness, and sometimes gruesome acts of violence by one peasant neighbour against another; it was not the haven of communal harmony that intellectuals from the city imagined it to be. It was simply that the individual interests of the peasants were often best served by collective activity (Figs 1997, 90).

Orlando Figes goes on to describe how the apparently collective will of the commune seen in public votes and decision taking was in fact “usually dominated by a small clique of the oldest household heads, who were often also the most

successful farmers” (1997, 90–91). Christiane Frirdich (2003; 2005) has claimed that a principle of prestige accumulation drove social relations within LBK communities, but personally I still find it hard to isolate this from a host of other factors, which I will sketch below.

Finally, as a theme within this socio-economic trope, there has been ongoing debate about descent principles and patterns of post-marital residence within LBK communities. The dominant inference has been, as far as I am aware, of patrilocal post-marital residence and patrilineal descent, seen for example in recent, detailed studies of the distribution of pottery decorative motifs on the Aldenhovener Platte (e.g. Krahn 2003; Krahn-Schigiol 2005) and through morphological and genetic traits at Talheim (Eisenhauer 2003). House replacement in the rows at the earliest LBK site of Schwanfeld has been seen in terms of a ‘father principle’ and a ‘grandfather principle’ (Lüning 2005a). There have been variations on this. Soudský suggested both matrilocality and matrilineality, while van de Velde proposed virilocality but matrilineality (summarised in Milisauskas 1986, 218). Milisauskas, by contrast, has observed that we may not be dealing with bounded corporate groups such as lineages or clans, and pointed to kindreds of bilateral descent, in which the transmission of descent is through both male and female lines (1986, 218; cf. A. Kuper 1988; Scheffler 1966; 1985; and see below). Debate since, however, seems to have fallen for the attractions of a simpler hypothesis, and seems also to be predicated on a model of small, closed, nuclear families (e.g. Bentley 2007; de Grooth 2005). What if patterns of co-habitation were rather different to modern marriages and partnerships? What if there was polyandry and polygamy in the LBK? And these may not have been stable, unchanging institutions or arrangements. Detailed study of the distribution of ceramic decoration within Vaihingen shows shifts through time, perhaps indicating family or closely grouped traditions only in some phases, when locally there are other indications of smaller and more dispersed settlements (Strien 2005). The idea of central places (Petrasch 2003) has presumably to be set in the same kind of shifting context.

What is to be done?

So far, so healthy. The papers here all fit, in varying ways, into established traditions in LBK research. Their geographical coverage is self-evident. Claßen and Rück discuss evidence which further consolidates the significance of northwest Germany. Amkreutz, Vanmontfort and Verhart also give a strong sense of thickening detail for the southern Netherlands, supported in turn by Lodewijckx and Bakels for central Belgium, and the papers by both Bickle and Bedault can be seen to take further the accumulating evidence from the Paris Basin. The contributions of Pechtl and Hofmann introduce, to English readers at least, the less familiar landscape of southern Bavaria. Significant new information on central Poland is given by Pyzel (cf. Pyzel 2005; Marciniak 2005), and Larina reminds us of the eastern facies of the LBK, probably too long neglected in such studies (compare again the coverage in Fitz and Makkay 1972).

There are familiar themes too, starting with hunter-gatherer/farmer relations, treated in interestingly diverging ways in the geographically complementary papers of Amkreutz *et al.* on the one hand and Lodewijckx and Bakels on the other,

the latter offering a more fluid and open view of the nature of identities and possible fusions.

The focus on regional scales of settlement is continued in several of the papers. The importance of that is strikingly seen in the contribution by Zeeb-Lanz and colleagues on Herxheim, where the astonishing numbers of human remains can be related to a very wide range of contacts seen in examples of regional pottery styles brought to the site. Pechtl also exploits the wider scale, importantly suggesting differences within a region, with big houses and enclosures as some kind of equivalent manifestation of a trend to social display and social pre-eminence. Rück (cf. Rück 2007) offers a critical look at settlement organisation, challenging accepted wisdom on the form of houses, their unitary construction, and their duration, and on the layout of settlements. A little more comment is called for here. The form of houses must rest an open question, and the author is not the first to speculate whether LBK houses had raised floors. I am less convinced by the general argument for modular additions to LBK houses, though it is not to be excluded that this was practised from time to time. Longer durations for houses than the 25–30 years proposed essentially by the big projects of the Aldenhovener Platte, the Graetheide and Bylany have already been mooted by Schmidt *et al.* (2005). This too must remain an open question. In essence, the short-life model rests on an informally estimated overall span for the post-earliest LBK divided by the numbers of phases given by seriation of ceramic decorative traits. No other formal modelling has been done (and see further below on chronology). It is, finally, premature to rush to replace the *Hofplatz* model with one based on house rows. Lüning (2005a) has already discussed Langweiler 8 in relation to Schwanfeld, suggesting that house rows, as seen at Schwanfeld, could have been an older principle, compatible with the *Hofplatz* idea, which was modified through time, and to some extent incorporated into a less regular and more varied *Hofplatz* layout. Once again, however, what may or may not hold good in northwest Germany need not apply rigidly elsewhere. Lastly, on the theme of scales of settlement analysis, Bickle explores the ways in which we can connect life within settlements with activity in the taskscapes beyond, uniting them both in a single perspective.

This theme of movement is picked up in other papers. Knipper brings more evidence from isotopic analysis, to set alongside those already quoted, for significant and recurrent movement of people and animals across broad landscapes. Bedault reports the variety of animals being exploited in the early 5th millennium cal BC VSG phase in the Paris Basin, and documents important evidence for river fishing. Ramminger offers an important summary for English readers of progress in tracking down the long elusive sources of amphibolite. Why did LBK people desire such things so much? Rauba-Bukowska also brings a very grounded study of pottery fabrics from southern Poland, with a level of detail and an approach of which Behrens would surely have approved. Is there further significance for the inclusion of bone beyond its technical properties and effect on pot fabric? Did it unite, at a conceptual level, the worlds of rooted daily life on settlements and of movement in the taskscapes beyond?

The report on Herxheim by Zeeb-Lanz and colleagues, extremely useful again for English readers, is a further illustration of the unexpected developments of field research. The picture from Herxheim offers a different perspective to those more

dramatic scenarios of conflict and crisis at the end of the LBK. It is entirely possible, of course, that both perspectives will have to be accounted for. The evidence from both Talheim and Asparn for violent deaths is compelling, even if one might wish for more chronological precision in the future. The seemingly different treatments of the Herxheim dead still demand an answer to the question of why such violence was visited on the deceased. But another dimension must be to do with concepts of death, and the relations between individual and community, and community and region. The paper by Hofmann, though on the different region of southern Bavaria, not only takes further the broader existing studies of LBK mortuary traditions (cf. Veit 1996; Jeunesse 1997; Orschiedt 1998), but poses the question of how to come to grips with differing contexts and kinds of deposition, which is useful in turn for thinking about situations like Herxheim. It leaves unanswered the question of why separate burial grounds were used, however much one can blur the distinction between the kind of mortuary practice within them and in settlement contexts, as her paper so effectively shows. Is there a trajectory in which burial grounds appeared close to founder or major settlements, as in the Niedermerz-Langweiler 8 relationship, and were dominated by leading households or families or lineages (depending on the social model of one's choice), to be superseded for a while in the late LBK by both more local and more regional arrangements?

So these papers are further proof of the vitality of LBK studies. There is no cause, however, for complacency. On the one hand, there is a long list, it seems to me, of technical, detailed questions which still need to be addressed. Prominent amongst these is the matter of chronology. As noted above, little formal chronological modelling has been done. The dating of the early site of Schwanfeld, for example, has been examined by visual inspection of nine wiggle-matched radiocarbon dates, to give an estimate of a site duration of 135 years (Lüning 2005a, fig. 13). It is not clear from the date lists (Stäuble 2005) whether all the samples in question are indeed short-life; Hd-14219 is from an articulated human burial, and OxA-1539 from cereals, but the others are animal bones. Are these from articulated or articulating remains? The seven samples shown by Stäuble (2005, fig. 167) relate to Houses 6 (one sample), 8 (two samples), 16 (three samples) and 18 (one sample) – only two structures per row. It is possible therefore that the Schwanfeld chronology could be ‘importantly wrong’ (Bayliss *et al.* 2007). If Bayesian chronological modelling is the currently best available method (Bayliss *et al.* 2007), which will counteract the inevitable scatter of radiocarbon determinations and, in combination with archaeological information, provide much more precise estimates of date and duration, it has yet to be applied to individual LBK sites. It is a moot point whether the larger edifice of LBK chronology as a whole is likely to be importantly wrong. Its latter parts are underpinned by dendrochronological dates from wells, as at Erkelenz, noted above. But the start date for the LBK, the duration of the earliest phase, and the extent of regional divergence in the Flomborn phase and subsequently, all seem to me to be open to question. Lüning (2005a, fig. 23) has suggested that the ‘earliest’ phase overlaps with the Flomborn phase. These questions should be open to testing in a Bayesian framework, though finding short-life samples that relate directly to associated diagnostic material may remain difficult in settlement contexts, and there is the matter of the late-sixth millennium plateau. A dating programme on closed finds from the graves of burial

grounds may be one way ahead. This is not just a technical issue. It has been shown that informal visual inspection of radiocarbon dates often leads to erroneous estimates that a given phenomenon started earlier, lasted longer and ended later than in reality (Bayliss *et al.* 2007). In that case, we might be looking, for example in the Aldenhovener Platte sequence (Lüning 2005a, fig. 22), at even more concentrated site phases and an even swifter replacement of houses (*pace Rück*, this volume).

Other technical issues can be found through the length and breadth of LBK studies. Just three further, interrelated examples serve to reinforce the general point. First, what sort of woodlands did LBK communities inhabit? Were these the same from region to region? Pollen studies have been achieved now in a number of regions (e.g. Bakels 1995; Kreuz 2008). One recent model is of more open, park-like woodland, maintained by large herbivores (Vera 2002). Though this in turn has been criticised (Mitchell 2005), the conditions and factors which could have promoted diversity can be stressed (Kreuz 2008). Secondly, what sort of cultivation regime did LBK people follow? As already noted above, one recent important model proposes ‘garden’ cultivation, of limited extent but considerable intensity and duration; autumn as well as spring sowing is a possibility (Bogaard 2004; Bogaard and Jones 2007; Bogaard *et al.* 2008). This replaces earlier suggestions that shifting cultivation could have been important (e.g. Soudský 1962; Whittle 1996). But is the garden model to be applied uniformly to each and every settlement cluster, settlement and house? Cultivation must have been a key strategy in the promotion of households (however constituted), and given variable histories for houses and the settlements that they constituted, it seems reasonable to suppose corresponding variability in the character and maintenance of plots. It has already been suggested for the Aldenhovener Platte that smaller houses mainly used grain that had already been processed elsewhere (Lüning 2000, 2002). Further detailed study of large sites such as Vaihingen (Amy Bogaard, pers. comm.) will be one way forward, and there is still much to learn about the cereals themselves (e.g. Kreuz and Boenke 2003; Kreuz 2007). Thirdly, what about the balance between cereal cultivation and animal husbandry, and indeed the balance between hunting and husbandry (cf. Arbogast 2001)? This notoriously difficult question is of course not specific to the LBK, but it is pressing within LBK studies. Wider sampling of human remains for isotopic dietary analysis must be one way ahead,² and much more concentrated studies of human dentition must be another, as achieved recently for the Vedrovice burial ground in Moravia (Marek Zvelebil, pers. comm.). And detailed site investigations must continue to be important, as at Cuiry-lès-Chaudardes in the Aisne valley, and Miechowice, Bożejewice and others in Kujavia, which have shown differences between households on the one hand and different patterns and kinds of consumption for cattle, pig and sheep/goats on the other (Hachem 2000; Marciniak 2005).

Once again, these are not just challenging technical or specialist issues. They affect how we see the diversity of LBK life on the ground. In his important study of the LBK, Peter Bogucki (1988) suggested that combating risk was central to longhouse life. Add to that closed woodlands, and prime importance for garden cultivation, and the resulting picture may be of a rather dark, restricted and inturned existence. Open the woods, however, and populate them with many more tasks and trips, and activity in general, allow variation in household production

strategies (both between and within households), consider gendered differences in activity and goals (cultivation by the women and herding by the men and boys?; cf. Lüning 2000, 201–02), and a much more diverse and dynamic world may come into view.

In addition to all this – and each and every one of the technical issues is vitally important – I want to reflect on the wider differences between current LBK studies and other investigations of the European Neolithic. I find relatively little use of analogy, though there are exceptions in the study of houses (e.g. Coudart 1998) and suggestions of unusual social personae (e.g. Gronenborn 2006). I find relatively little discussion of agency (for an obvious exception see Sommer 2001), or materiality. Tim Ingold (2007) has recently railed against the term ‘materiality’, advocating closer attention to the conditions and textures of materials themselves. Following this line, can we not do more with the many things that LBK people desired: the smoothness of adze blades, the rhythm of pot decoration, or the colour (and the sound of far away?) in *Spondylus* shells? We could take a leaf out of the Mississippian book to unite ideas of agency and physicality and to look again at ‘humble’ postholes and posts, as embodiment of cultural construction and contestation (Pauketat and Alt 2005; cf. Souvatzi 2008). We could exploit a rich literature on architecture to explore what all those post arrangements, those openings and closings, those separations and unities, might have meant emotionally (cf. Bahloul 1996). I do find some appealing, wider ideas, principally (and perhaps worryingly) from British authors – on the principles of *domus* and *agrios* (Hodder 1990), on house orientations and ideas of origins, on multiple identities (Bradley 2001; Jones 2005), and on deep-seated traditions and practices of commemoration (Jones 2007) – but these are either over-generalised or too partial.

So beyond all this, what’s the big idea? To set an agenda restricted to tracking regional and temporal trends in diversification may miss the point, since there may not have been uniformity in the first place. History and memory, connections and community, seem important threads. But I want to write down a long list of other key ideas when I contemplate the LBK, in no particular order: places, conviviality, competition, fragility, permanence, independence, belonging, near and far, local and distant, face-to-face and wider networks, past and present, whole and parts, house and body, common ancestry and specific descent, smooth and rough, sculpted and natural, young and old. At times I want to arrange these kinds of lists into opposing columns (such as past versus present, permanent versus fragile, old versus young, distant versus local, community versus household, house versus body), but at others my sense is that it is both the potential combinations and the messy, loose ends which are also important.

I would like to see the current, dominant concerns with economy and some aspects of social relations (as explored above) set within wider interpretations of LBK worldviews. This would be to revive an older tradition of enquiry. Alongside his grounded and particular archaeological questions, and his mistrust of theoretical skyscrapers, Hermann Behrens (1973, chapter 4) quite straightforwardly looked at matters of consciousness, emotion, concepts of death and mortality, the apotropaism of mortuary rituals, and belief in supernatural forces. Quite unselfconsciously, it seems to me, he lists death, birth, illness, sexuality and ‘Nahrungsbeschaffung’, or subsistence practices, as key elements in a

religious outlook which involved not abstract book knowledge but active and material relations of reciprocity with gods and spirits (Behrens 1973, 242–47). This reminds me of the work of Janos Banner (1937) on the Körös culture, and an older, much more adventurous, European interpretive tradition in general.

As I noted earlier, this kind of approach has been much more muted during the years since Behrens wrote, while so much has been achieved in other ways, and I believe that it is time to revive it. Recently, Jens Lüning (2005b) has used LBK figurines not only to reconstruct both male and female clothing but also to envisage a series of elders and specific ancestor figures; he has also made passing reference (2005a, 202) to the religious ‘Weltbild’ of the LBK, suggesting that animals do not appear to have been a major part of that due to the infrequency of animal figurines or other representations. Andrew Jones (2007, 96, 103) has also referred in passing to the ‘cosmological’ dimensions of house orientation and infant settlement burials of the LBK, but without setting out a fuller cosmology.

How can we begin to unite all these wider possibilities with existing strengths in LBK research? I think that history was important, especially but not only of the indigenous people. The fusions of the mid-sixth millennium cal BC brought new practices to the woodlands of central and western Europe. They created an enduring importance for the longhouse because of that history, and beyond that there were older histories still, of indigenous people and of people from the south. The longhouse continued, the basis for a ‘house society’ (cf. Borić 2007), because it was both a social and historical fact in its own right and able to contain diverse occupants and occupancies. Different people invested in it in differing ways, and the analogy of the Amazonian longhouse which was both male and female, shelter and representation of the cosmos (floor as earth, posts as mountains which support the roof as sky), and locus for group solidarity but open to outsiders in the right circumstances (Hugh-Jones 1995), is one of a series with which we could do much more. People brought the woods into the house, and took themselves into the woods. Their lives were rooted in a kaleidoscope of varying foci: from house part or compartment to the whole house; from house space to the settlement as a whole; from settlement or settlement ribbon to the surrounding taskscape; from local region to a wide world beyond from which exotics like shells and axes came at intervals; and so on. These people were guided by principles of interaction and perhaps reciprocity. The past was active in several dimensions, from a sense of origins to remote ancestors, from the continuity of the longhouse as both idea and fact to immediate forebears, perhaps all the more complicated if not traced simply down male or female lines but through the medium of much more open descent groups (cf. Scheffler 1966, 544; 1985, 10; Whittle 2003, chapter 5). Building, working in and maintaining gardens, moving cows across the landscape, acquiring materials from distant sources and being part of the networks that made all that possible, could all be seen in part as relationships with the past and forebears. They were also the embodiment of relationships with the living. The dead may have mediated between these two (or more?) dimensions, both in the context of the formal burial grounds and in the intense sociality of the longhouse settlements. This was probably not an entirely harmonious world, and we have to incorporate both the newer evidence for interpersonal and inter-group violence and older models of some degree of social differentiation, even if only measured by varying longhouse sizes and varying site sizes and durations. But the longhouse world

endured, with changes, for a thousand years or so, and so it is hard to see a persistent or unbearable degree of social tension. That the longhouse could lodge history and cosmos, diverse occupants and relationships, the living and the idea of the dead, all under one roof, perhaps made this possible.

Acknowledgements

Thanks to Dani Hofmann and Penny Bickle for persuading me to write this paper, and to them and Sarunas Milisauskas, Detlef Gronenborn, Inna Mateiciucová, Angela Kreuz and Dušan Borić for advice, information and references.

Notes

†There are archaeologists who would construct a skyscraper of theories on very little material". Translation by the editors.

‡A major collaborative programme for central Europe, funded by the Arts and Humanities Research Council, has started in October 2008 under the direction of the author.

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